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FRENCH BATTLESHIPS REPUBLIQUE AND PATRIE.

BY J. PELTIER.

The first two battleships of the 1900 naval program have finished their trials with very satisfactory results. These ships have a waterline length of 439 feet, an extreme beam of 79 feet 7 inches and a draft of 27 feet 5 inches, corresponding with a displacement of 14,867 tons. This gives a block coefficient of 0.543. The frame spacing is 3 feet 10 inches, and the hull below the lower of the two protective decks is divided into fourteen main watertight compartments, each of which is subdivided into smaller compartments. The double bottom extends between frames 6 and 94, and up to the lower protective deck plating.

THE FRENCH BATTLESHIP REPUBLIQUE AT ANCHOR AFTER OFFICIAL TRIAL TRIP.

In this double bottom are located the liquid fuel tank and the fresh water tank. Bilge keels are fitted, with a length of 216 feet 6 inches. Below the lower protective deck there are on each side seven keelsons and stringers.

PROTECTION.

The armor belt extends from the stem to frame 108, having a total height forward of 18 feet 5 inches; amidships, 12 feet 6 inches; at the stern, 10 feet 3 inches. The height of this belt above the waterline is 7 feet 7 inches astern and amidships, and 8 feet 7 inches forward. The upper edge of this belt has a maximum thickness of 9½ inches, tapering to 6½ at the ends; the waterline has a maximum thickness of 11 inches, tapering to 7; the lower edge is 4 inches amidships, and 3 inches at the ends. This armor is laid upon double plating, 0.8 inch thick, with a teak backing of 3 inches. A light strake of armor between the upper protective deck and the gun deck extends from the stem to frame 28. This is 2½ inches thick, and is backed by double plating, measuring ½ inch, and 2 inches of teak.

The lower protective deck is slightly above the load waterline at the center of the ship. At the sides, it is 5 feet below the waterline, and is connected to the lower edge of the armor belt. This deck has ½-inch plates, covered with armor of a thickness of ¾ inch on the flat and 1⅓ inches on the slopes. The upper protective deck is horizontal, and extends from stem to stern. It is connected with the upper edge of the belt armor and is ¾ inch thick. Between the protective decks, and behind the armor belt, is a cofferdam extending 4 feet above the waterline, and filled with cellulose. Back of this is a passage for inspection. At frame No. 108, near the stern, is an athwartship armor bulkhead, 8 inches thick, extending between the protective decks.

All turrets, casemates and the conning tower have armor running down to the protective deck, the great bulk of the side of the ship above the upper protective deck being unarmored. A

conning tower on the forward lower bridge has 12-inch front plates, 10-inch rear plates and 8-inch shield. The top is 2 inches thick, while the bottom is 1.6 inches. An armored tube, running to the communication room below the lower protective deck, has an inner diameter of 12 inches, and a thickness of 8 inches above the upper protective deck, and 1.2 inches below same.

The barbettes for the 12-inch guns measure 4 inches in thickness between the protective decks, and 12 inches from the upper to the gun deck. The forward pair of guns being located on the spar deck, the barbette above the gun deck has a thickness of 11 inches. The turrets for these guns have front and rear

BOW VIEW OF PATRIE, SHOWING HOLLOW WATERLINES.

plates measuring 12.6 inches, with top plates of 3 inches, and splinter plates, 3½ inches. The 6.4-inch gun barbettes have two tubes, of which the exterior, extending from the upper protective deck to the spar deck, has a thickness of 0.8 inch. The inner tube measures 3 inches thick down to the upper protective deck, and 1.2 inches between the two decks. The turrets for these guns have front and rear plates, 6.3 inches; top plates, 1.6 inches; and splinter plates, 5 inches.

The casemates for six of the 6.4-inch guns have outside plating of 6.3 inches, and inside plating 4 inches, with floor and top plates 0.8 inch.

BATTERY.

The main battery includes four 12-inch guns in pairs in turrets on the center line forward and aft, and eighteen 6.4-inch guns. Six of the latter are in casemates, while twelve are mounted in pairs in six turrets on the spar deck. The secondary battery includes twenty-four 3-pounder, and three 1-pounder guns. The battery is so disposed that the forward and aft fire includes two 12-inch and ten 6.4-inch guns; while the broadside includes four 12-inch and nine 6.4-inch guns.

There are five torpedo tubes, of which two submerged tubes are located forward, and pointed 19 degrees respectively on each side of the keel line. One tube is aft above the waterline, while the other two are abreast the forward 12-inch turret, and fire through the upper strake of 2½-inch armor.

MACHINERY.

The ships are propelled by three screws, each actuated by a triple expansion four-cylinder engine in a separate watertight compartment. The cylinder diameters are respectively 35, 49, 55 and 55 inches, with a stroke of 41½ inches.

Steam is supplied by twenty-four Niclausse watertube boilers, located in three boiler rooms, each served by a separate funnel, two groups being forward of the engines and one aft. The total grate surface is 1,378 square feet; the heating surface, 46,049 square feet. This makes a ratio of 33.4 to 1. The working pressure is 251 pounds per square inch, reduced to 237 pounds at the engines. Each boiler contains fifteen elements of twenty tubes 8 feet long. These tubes have an exterior diameter of 3.4 inches, and 3 inches interior.

There are two sets of evaporating and distilling apparatus, with a capacity of 19,000 gallons of water a day. The ship is heated throughout by steam. The electric installation includes four dynamos with a normal output of 1,000 amperes at 83 volts, and an overload output of 1,300 amperes at 82 volts. The turrets, ammunition hoists, steering gear and boat winches are driven by electricity. There are twelve electric fans for ventilating, with a combined capacity of 1,700,000 cubic feet of air per hour. There are six 24-inch searchlights; two located forward; two aft and one on each mast. These require 75 amperes.

The normal coal supply of 900 tons may be increased when necessary to 1,850. This gives a steaming radius at 10 knots estimated at 4,200 miles with normal supply, and 8,500 miles with full supply.

TRIALS.

The *Patrie* was tried in August and the *République* in September of 1906.

Full Speed Trials.	*Contract.*	*Patrie.*	*Répub-lique.*
Number of boilers at work	24	24	24
Grate surface, square feet	1,378	1,378	1,378
I. H. P.	17,500	19,859	19,626
Consumption of coal in pounds:			
per horsepower hour	...	1.825	...
per square foot of grate	24.6	23.5	23.9
Average speed for four hours	18	19.125	19.15
Admiralty constant	201	213	216.5
Normal steaming radius	...	1,048	...
Twenty-four Hour Natural Draft Trial.			
Number of boilers	24	24	24
I. H. P.	10,000	11,660	10,965
Coal consumption per I. H. P.	1.65	1.58	1.56
Mean speed	...	16.82	16.74
Admiralty constant	...	247	259
Normal steaming radius	...	1,810	1,940
Low Speed Consumption Trials.			
Number of boilers	3	3	3
Grate area	172	172	172
I. H. P.	1,050	1,233	1,263
Coal consumption per I. H. P.	1.54	1.3	1.25
Average speed	...	7.9	7.8
Admiralty constant	...	242	227
Normal steaming radius	...	9,780	9,790

The official four-hour trial in each case took place in heavy weather, which makes the increase in speed of more than a knot particularly praiseworthy.

The *Patrie* has made further coal consumption trials. With the engines operating at 60 revolutions and developing 3,370 I. H. P., a speed of 10.4 knots was obtained with a consumption of 1.44 pounds per horsepower hour. This corresponds with an Admiralty coefficient of 202, and a radius with normal coal supply of 4,260 nautical miles. With the engines making 76 revolutions and developing 7,364 horsepower, a speed of 15.2 knots was obtained with a coal consumption of 1.62 pounds per horsepower hour. This corresponds with an Admiralty coefficient of 288, and a radius of action with normal coal supply of 2,530 miles. These results appear to be somewhat discordant.

In November the *République* made other trials, one for ten hours, at 17,620 horsepower and 18.85 knots, with only 18 furnaces lighted. The combustion per square foot of grate was 34 pounds. Another trial with all boilers in use gave the same power and speed on a combustion of 23.6 pounds per square foot of grate.

THE PATRIE STEAMING AT FULL SPEED AND THROWING UP GREAT VOLUMES OF BOTH WATER AND SMOKE.

COMPARISON.

These vessels are of about the same size as the American battleship *Virginia,* which was ordered in the same year. The French ships have about the same bunker capacity and average full speed, but as the speed is obtained on a lower consumption of power, it would appear that the French hull was better designed for the attaining of this speed than was the American. In this connection it may be noted that the *République* is 3 feet 4 inches broader than the American ship, and, as she has about the same length, and a greater draft by 3 feet 8 inches, it is seen that she has a much finer block coefficient, this being 0.543 as compared with 0.665 for the *Virginia.*

So far as the heavy belt armor is concerned, there is about an equality between the two ships; but, when considering the entire protective elements, it is seen at once that the American vessel, with a high casemate of 6 inches of armor, covering 246 feet of the central part of the ship, gives much the better result, as the portion of the vessel exposed to attack by high explosive shells is so much more ably protected. The protection from this point of view in the French ship is simply at the stem, the idea being to secure ability to steam at high speed, even after a severe attack, whereas the American ship, being comparatively unprotected above the main belt at this point, would be liable to ship a great deal of water.

The main superiority of the American type consists in her armament. Assuming that the 12-inch guns in each case are of equal value, it is seen at once that the 8-inch guns of the *Virginia* have a range of destructibility much superior to the 6.4-inch guns on the *Patrie.* If the range is reduced to such a point that the 6.4-inch guns are effective, the American vessel could bring into service her 6-inch guns, there being mounted twelve of this size, and eight 8-inch. It is somewhat doubtful, however, under ordinary conditions, whether the *Patrie* could approach within such a distance without being so badly damaged by the American heavy guns as to be virtually placed out of action. The secondary battery on the American ship is immensely superior to that of the French, both as to number of guns and as to caliber. There are a large number of 3-inch (14-pounder) guns, which are very much more powerful than the 3-pounder guns on the *Patrie.*

Electric Safeguards at Sea.

BY A. S. ATKINSON.

Each new ship of our great transatlantic steamship companies shows the rapid development and improvement in electrical installation for various useful and ornamental purposes; and the recent arrival of the *Amerika* and the *Adriatic* with electric elevators between decks, and submarine signaling systems installed, as well as wireless telegraph apparatus, indicates in an important way the large part which electricity is playing in shipbuilding. A steamship to-day is not considered up to date unless its builders make the fullest use of electrical appliances, and marine architects appreciate thoroughly not only the convenience, luxury and usefulness of electrical apparatus for steering, controlling bulkhead doors, operating deck winches, heating, lighting, and cooking by electricity, but as well the economy of space effected, and safety from general fire accidents.

This latter feature of the subject is a factor that has received a good deal of attention from competent marine architects and experts. According to the marine insurance companies the dangers at sea to cargoes and ships are divided into two general classes—fire and water. The former danger is reckoned at about 25 percent, and the latter 75 percent; or, in other words, the dangers from storms, heavy seas, and collisions are about three times those from fire. Wireless telegraphy, submarine signaling, and electrically-operated bulkhead doors are inventions which tend to eliminate many of the risks to life and property at sea from water; but the danger from fire is still a factor which counts strongly with those who engage in carrying highly combustible materials from port to port.

The extensive introduction of electricity on modern ships has tended to eliminate many of the old fire risks, and like all improvements, it has added a danger all its own, when the system is not properly installed. The electrical fire hazard at sea is thus a real danger which has induced marine architects to make provision against risks of this character. The electric wiring of a

ship is an intricate piece of work, requiring unusual expert knowledge of the subject. Marine insurance companies have lately taken up the subject, and new rules for the guidance of those engaged in the work are in the course of preparation. An examination of many of the old boats for sound and river use, and a few of the older class of ocean steamers, shows that fires started from electrical sources are due almost entirely to carelessness, ignorance, or the use of obsolete methods of wiring. In developing new systems and appliances for ships, inventors in too many cases have overlooked the question of danger, and the electrician has had to adapt them to practical use so that risks by fire are eliminated.

The wires of a ship represent an intricate network of nerves. The placing of these wires so that they will not cross and cause short circuiting is of prime importance. Marine underwriters require that all wires on shipboard be doubly insulated, and carried, so far as possible, in metal tubes. Experience has shown that insulation of electric wires deteriorates quicker on shipboard than in buildings, owing to the corroding effect of salt air and water. Most of the wires used on such steamers as the *Amerika* are carried either in rigid and watertight iron conduits, or in flexible metallic or armored conduits. The electrical experts adopted these methods, owing to the risks of fire that come from collisions and other mishaps at sea. A slight collision that staves in the forward bulkhead might cause a short circuit of wires controlling the operation of the doors, unless carefully protected, and thus start a fire. A number of cases have occurred at sea where fires of electrical origin were started through slight mishaps in encountering unusually heavy seas. The destruction of parts of the forward partitions through the violent shocks have exposed improperly protected electric wires, so that short circuiting naturally followed. On shipboard to-day the very best rubber for insulation is used, and also every safety appliance that has proved of value.

The construction of the dynamo room and machinery on large ships is of special importance and interest. Recognizing the dynamo room as the possible source of risks by fire, the marine architects have sought to eliminate so far as possible all factors of danger. The compartments are rendered entirely fireproof. They are located as far from the coal bunkers and cargo compartments as conditions permit, so that any escaping gases from the coal must traverse a long distance to reach the electrical machinery. The rooms are completely inclosed in fireproof partitions, with no possible connection with other parts of the ship except through the doors, which are waterproof and airproof. In addition to this, the fuses of all the switchboards are inclosed either in fiber or glass tubes, so that any flashing or blowing out of fuses cannot possibly start a fire, even though the air of the room is surcharged with coal or other inflammable gas. There is not a particle of wood employed in the dynamo room, and the place is as near perfection as science can render it.

Greater flexibility of wires is required on shipboard than on land, especially at what are called working joints of the vessel. At these points the feed wires for heating, cooking or power purposes must possess a power of flexibility and adaptability quite unnecessary on land. A building is firm and solid, and wires once installed are seldom injured; but a modern steamer is a floating and unstable foundation. In very heavy storms the degree of strain and flexibility of the ship is considerable. Wires can easily be torn from their fastenings at such moments, at the working joints of the vessel, unless provision is made for their free action. Heavier insulation and purer rubber are consequently used to prevent any disruption of the insulation, and a lead covering is usually employed to protect the heavy feed wires at the points where the strain is the greatest. In tests instituted both in American and English shipbuilding yards, it was found that ordinary collisions might tear the network of wires from their fastenings and tangle them up in a mass, without necessarily destroying the insulation and uncovering the wires to a dangerous degree. The high art of insulation and installation of the wires on a modern ship is consequently one that illustrates better than anything else the strides made in recent years in eliminating the electrical fire hazard.

The installation of fire alarm systems on modern high class steamers is a further development of the electrical art that is particularly interesting at this time. The danger of fire at sea is half controlled if the source of it can be discovered at the very beginning. If it starts in the cargo it is a simple matter to-day to either extinguish it altogether, or to smother it in one compartment by closing the bulkhead doors. Thus a steamer may carry a fire in one compartment for a week, without greatly risking the lives of the crew or total destruction of the cargo. But to accomplish this, the fire must be discovered early, and proper precautions taken to limit its spread.

The need of instant fire alarms is more important at sea than on land. Efforts have been repeatedly made to devise some system to accomplish this. The use of the thermostat on shipboard has had this object in view. This has partially solved the problem, and a good many cargo ships have been equipped with the thermostat system of fire alarm, but the fact that it does not always work has proved its weak point. Marine underwriters have established certain rules for the installation of this system, but even with these precautions, fires have sometimes got under a good deal of headway in ships' holds before the alarm was given. This may be due to some slight derangement of the mechanism or to poor installation, which permits dust, moisture or acid corrosion to injure the spring whose expansion sets off the alarm.

The question of an adequate electrical fire alarm on shipboard has been one that has long attracted the attention of scientists. Such a system would have to be as perfect and dependable in its operations as the signaling and telephone system. It has been proposed to unite the two, so that the fire alarm system could not get out of order without interfering with the telephone and signaling system, thus automatically announcing the trouble before an emergency occurred that might cause irreparable harm.

One electrical fire alarm method now being tested on shipboard consists of wires distributed over the vessel in such a way that any sudden overheating of the parts will cause all the connecting bells to ring until the circuit is shut off by human interference. The system is absolutely waterproof, so that if a fire was started where the wires were partly submerged, as in the case of a collision, the alarm would still be given. The wires for this fire alarm system consist of a central core or conductor incased in a fusible metal which softens under heat, and expands so that it comes into contact with a copper sheath to close the circuit. The whole is inclosed in a copper tube, the inner surface of which forms the second conductor of the closed circuit.

Every part of this copper tube is supposed to be a reliable thermostat, very sensitive to temperature, and affected when the heat reaches a point just below that sufficient to cause ignition of ordinary material. If the cargo of a ship generates heat to the danger point of ignition, the fusible metal is softened and expanded so that the electrical circuit is closed. The closing of the circuit immediately rings bells in different parts of the ship, and they continue to ring until the fire is discovered, and proper steps taken to extinguish it.

The application of this system to ships which carry cotton, coal, oil, and other materials of a dangerous character is quite patent. The wires run in coal bunkers, near ash bins, elevator shafts, and cargo holds would serve to give ample warning of rising temperature. It is even proposed to bury the wires in inflammable and combustible cargoes and coal bunkers, to warn the crew of any sudden internal combustion below decks. The wires are made of standard sizes, so that they will be set off at any degree of temperature from 160 to 370 degrees Fahrenheit. When the temperature of a room or coal bunker rises to the point at which the wire is designed to operate, the circuit is instantly closed, and the fusible metal forms a permanent seal, until removed.

Such a continuous thermostat makes it possible to wire every

vulnerable part of the ship, from the cabin and engine room to the coal bunkers and cargo hold, so that an incipient fire can be detected before it has actually started into flame. So far, this system has not been improved to the point where the alarm indicates the exact location of the fire. It is only by examining the different parts of the exposed wire to find the break that it is possible to localize the trouble. On ships where the telephone and signaling systems are in use, the fire alarm wires can be used so that they will perform double service. The rising of temperature beyond the point of safety in any part of the ship would thus cause all of the call and telephone bells to ring continuously.

Coal fires on ships, caused by spontaneous combustion, have been responsible for some of the worst losses at sea, and a fire once started below in the coal is the most difficult to reach and control. The hold of the ordinary ocean steamer or man-of-war is filled with coal to a depth of twenty or twenty-five feet, and the movement of the vessel causes this to pack so hard that it is almost a solid mass. Combustion usually begins a few feet from the bottom of this coal pit. The heat from the boilers and furnaces frequently raises the temperature in the coal bunkers to such a point that spontaneous combustion is easily started. On a modern warship the coal bunkers can be flooded with water to protect the powder magazines from explosion, and on merchant vessels the bunkers can be closed so tightly that the fire is smothered for lack of oxygen. But in either case an early fire alarm is the most important protective step that can be instituted. The most modern fire fighting apparatus and drilled crews are helpless in face of a fire at sea that has gained considerable headway before being discovered.

Marine insurance underwriters make rebates to vessels, according to the value of their equipment of fire fighting apparatus and fire alarms. The ship telephone and electrical signaling apparatus figure as important factors in the adjustment of insurance rates. Both of these systems are considered as protective fire systems which tend to limit risks. The perfect system of telephonic communication established over a ship keeps the crew and officers in such close touch that an outbreak of fire is quickly discovered and reported. Likewise the use of the electrical bulkhead door control is considered in the adjustment of insurance rates, for the necessity of quick action in smothering a fire in a single compartment is recognized as a great protective feature. More recently the use of wireless telegraphy on shipboard has come in for a share of attention from underwriters. A ship on fire at sea can signal her distress to the shore or other ships, so that help could be quickly rendered. A fire breaking out on a steamer several hundred miles at sea might not prove disastrous, for fire-fighting sea-worthy tugs are held in readiness at most of our ports to respond to such emergency calls.

In other words, electricity in its various forms has greatly lessened the danger of fire at sea, and the constant improvements in this direction tend more and more to make nearly all other forms of fire alarm and control obsolete. The marine architect appreciates this so well that every ship that comes off the stocks employs electricity more fully and completely than any of its predecessors.

The New Steamship Roanoke.

The trial trip of the finely modelled, clipper stemmed steamer *Roanoke*, which took place on March 13, adds another large deadweight carrying vessel to the fleets built and controlled by Furness, Withy & Company, Limited, and she will be further supplemented shortly by a sister vessel now being fitted out at the Middleton shipyard of the builders, at Hartlepool. The speed attained was 11 knots.

The *Roanoke* is 387 feet in length, and is built on the shelter deck principle, with a tier of beams, taking the highest class in British Corporation Register. The deadweight exceeds 7,000 tons, with a measurement capacity of 413,859 cubic feet, giving 10,346 tons at 40 cubic feet per ton. The hatches are of large size, allowing of bulky stowage in holds, and the 'tween decks are available for the carrying of live cattle. Cellular double bottom is arranged all fore and aft, a large deep tank fitted just aft of the engine room bulkhead, in addition to the large after peak, being available for water ballast. This will enable the vessel, when required, to make a light outward Atlantic voyage with safety, the total water ballast thus available exceeding 2,000 tons. She is most efficiently ventilated throughout. Special attention has been given to all derricks and lifting gear. There are nine powerful steam winches, a steam ash hoist, winch condenser, steam heating in all 'midship accommodation; and her equipment throughout includes all the most modern auxiliaries pertaining to a first-class, up-to-date cattle and general cargo steamer.

These vessels are especially intended for the Rotterdam-Antwerp to Baltimore general trade. The outward cargoes will consist of pig iron, machinery, Dutch cheese, china clay, dried fish, crockery, hides, etc., and the homeward freights will be tobacco, grain, wheat, cotton seed, copper, oils, oil cake, sugar, flour, lard, tallow, dried apples, provisions, lumber, etc.

A CLIPPER SHIP IN THE BALTIMORE TRADE.

The engines are of the triple expansion type, with cylinders 25, 40 and 68 inches in diameter by 48 inches stroke, and are capable of indicating 2,000 horsepower at a speed of 70 revolutions per minute. The high-pressure cylinder is fitted with a piston valve, and the intermediate with a flat slide valve balanced on the Martin & Andrews principle; the low-pressure valve is of the double ported type. Each cylinder is supported at the front by a cast iron column, and at the back by columns cast with the condenser, the latter forming part of the framing of the main engines. The valve gear is of the ordinary Stephenson link motion type, the reversing engine being arranged on the center front column, and fitted with a control valve, so that it may be easily manipulated in either direction. All the shafting is of ingot steel, the propeller shaft being fitted with a continuous gun metal liner cast in one piece.

Steam is supplied by three single ended boilers 14 feet 6 inches diameter by 11 feet long, working under natural draft, and at a pressure of 180 pounds per square inch.

The engine room auxiliaries are very complete and include a thunderbolt governor, feed water filter, winch condenser, evaporator, steam ash hoist, etc.

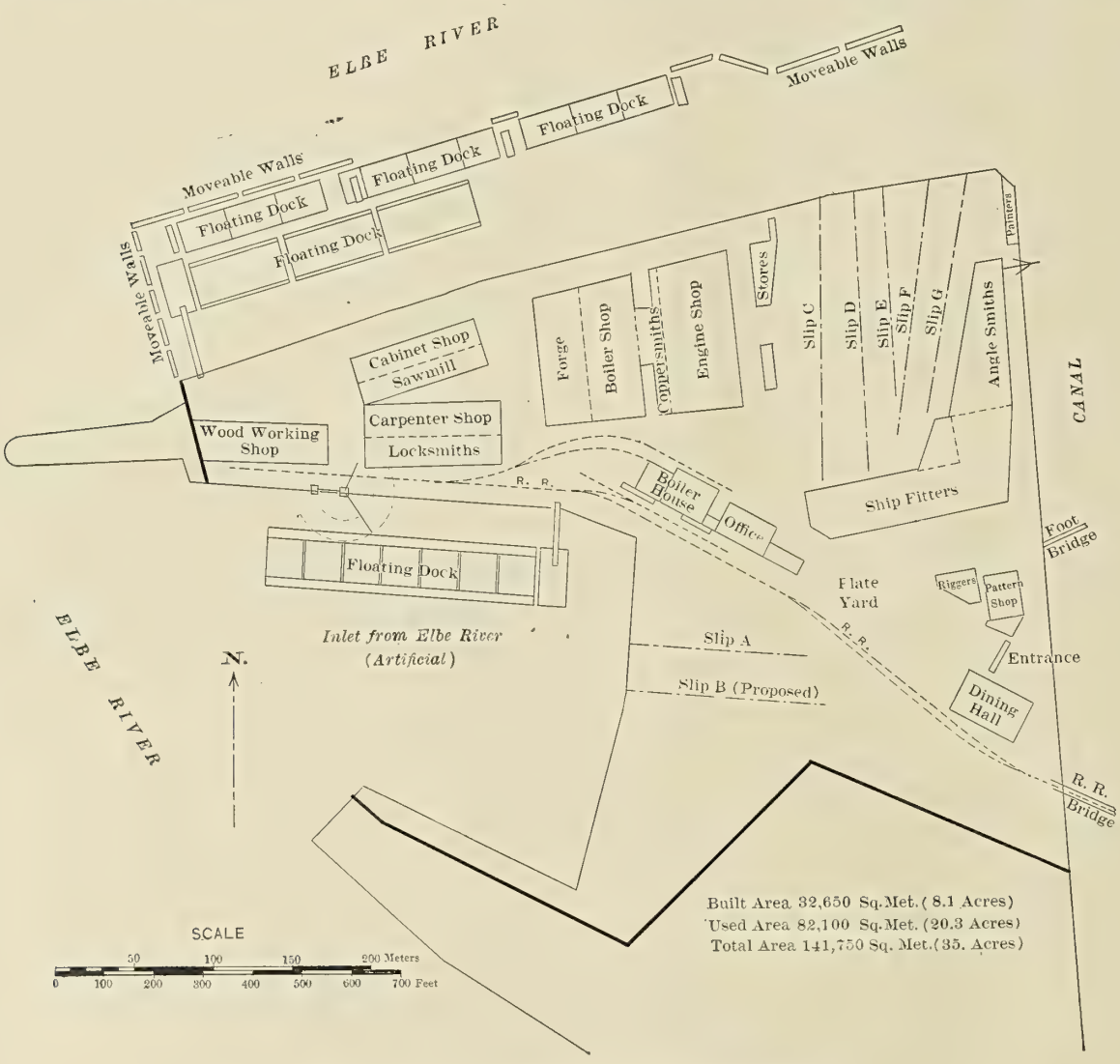
A contemporary humorist has suggested that new American battleships should be given such names as the following: *Simply Fierce, Abominable, The Limit, Hot Proposition, Perfectly Lovely, Outersight,* and *Nasty.* These names were suggested by observing the names given to British ships, such as *Dreadnought, Implacable, Vengeance, Devastation, Terrible, Superb, Foresight,* and *Brilliant.*

GLIMPSES INTO SOME GERMAN SHIPYARDS.

BY HAROLD A. EVERETT, S. B.

BLOHM AND VOSS.

A representative yard building general merchant steamers from 300 to 600 feet long is that of Blohm and Voss, at Steinwarder, a suburb of Hamburg. This yard was established in 1877, and has had rapid and practically continuous growth ever since. Located so near to Hamburg, it is but natural that it has a considerable amount of repair work, and of its several floating docks it is seldom that two are vacant at the same time. Wages are higher through this section than in any other shipbuilding district in Germany, due to its proximity to a large city; but machinery extensively used, serves as a partial offset, by reducing the number of laborers to a minimum.



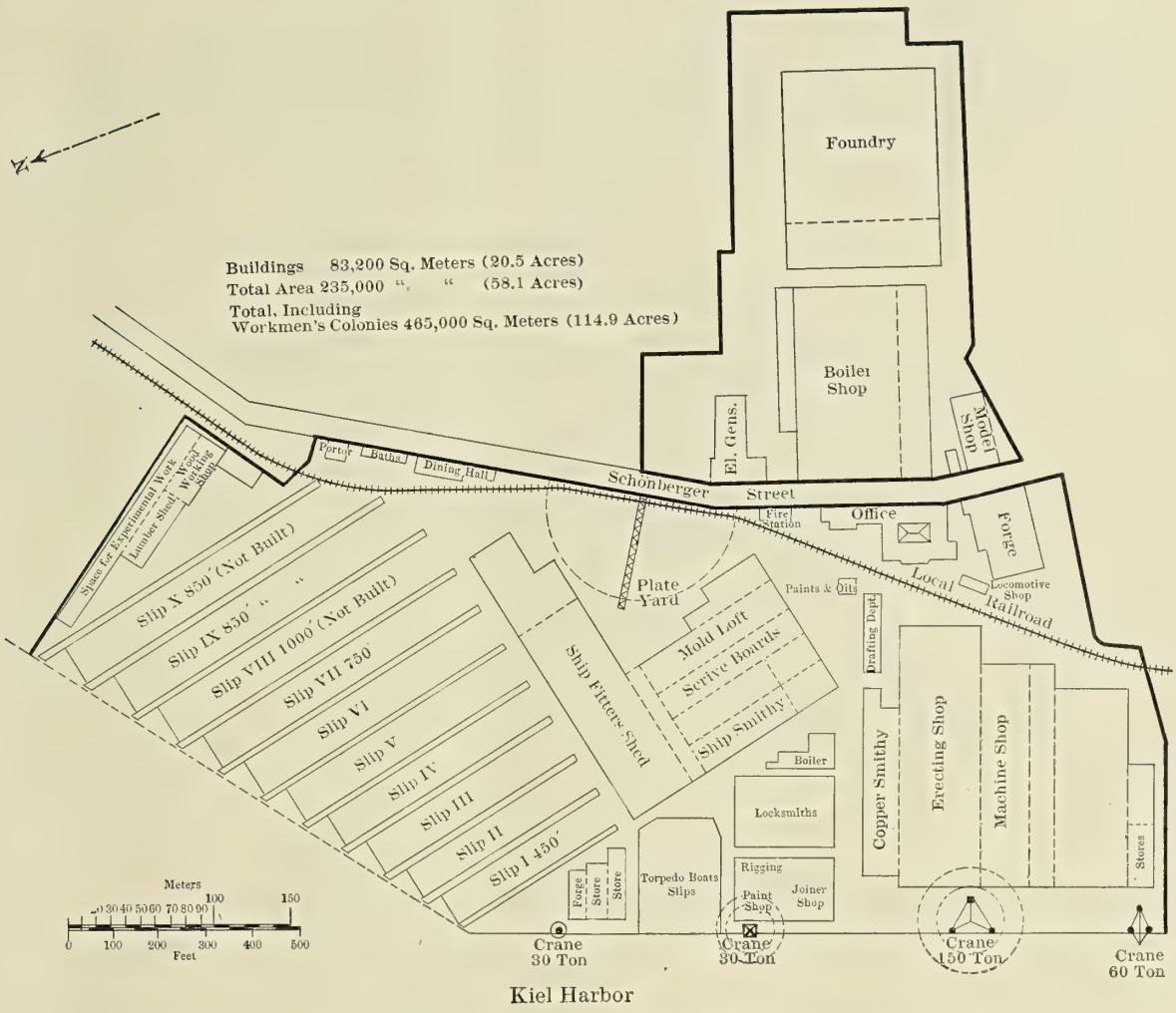
PLAN OF THE YARD OF BLOHM AND VOSS, HAMBURG, GERMANY.

The yard is located on a peninsula which is almost an island, and readily adapts itself to the desirable arrangement of having building slips located on both sides of a central platers' department. The yard covers about 37 acres, and employs from 4,500 to 5,500 men, the majority of whom live in Hamburg. The engine department is centrally located in the yard proper, and is close to the river front.

There are at present five adjoining building slips and one detached, though this is soon to have another one laid out beside it. These two, *A* and *B*, in the plan, have been located in this detached position to allow advantage to be taken of the artificial inlet from the Elbe river. When launching from the berths *C* to *G*, the pontoons at the lower ends of the slips are removed, and the floating fence further out in the river is taken away. A patrol of tugs then keeps the river clear of shipping, and the ship is launched into the river. As it is a very busy place here, a launch is always more or less of a vexatious incident, especially if there is the slightest hitch. By locating the slips at *A* and *B*, so they launch into the inlet instead of into the river, a great deal of this preparation and expense is avoided. The largest floating dock is located in this inlet, and on the bank of it is situated the heavy stationary crane. Though a slight tide prevails here, the slips extend below the water level as in the Stettin yard, and are closed by removable pontoon gates similar to those used in drydocks, apparently a step in advance of the wooden cofferdams used in some yards, which have to be torn to pieces at launching.

This yard has no crane sheds, as all slips are served by electrically driven jib cranes, three cranes to a slip, each vertical having two heavy and two light jibs. All of the topping lifts are made fast, a practice almost invariably followed where jib cranes are used, owing principally to the added complexity of the adjustable topping lift, and the danger of its being carelessly slacked off when the crane is loaded.

Pneumatic tools are largely used, though for riveting they are still looked upon with some suspicion. Most of the commercial ships are of the "solid floor on every frame" type, with one or two intercostal longitudinals. Apparently no attempt is made to have these longitudinals steel tight between the floors, as is done in some of the Scotch yards. The electric drive is used practically throughout the yard.

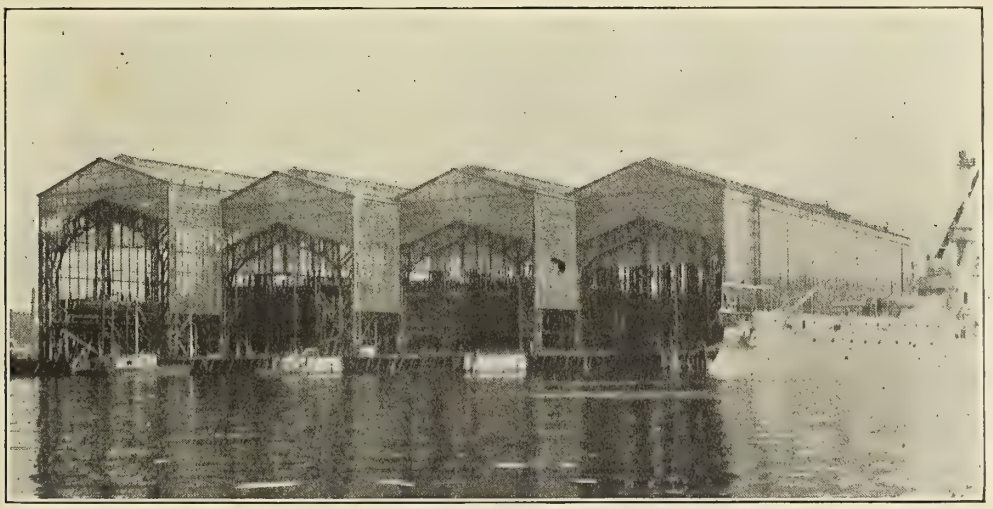


PLAN OF THE YARD OF THE GERMANIA WERFT, KIEL, GERMANY.

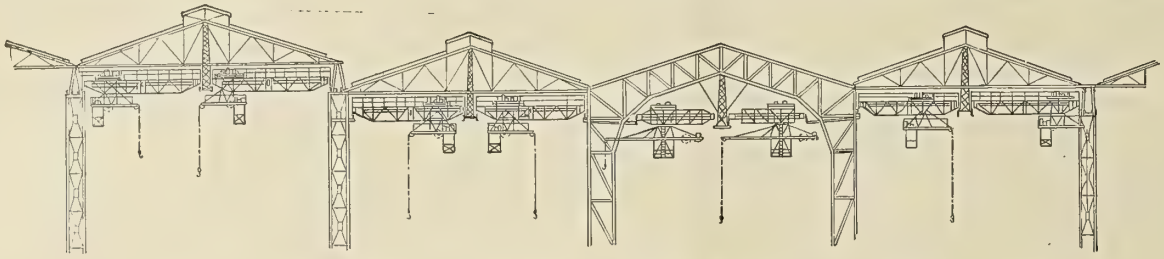
THE GERMANIA WORKS.

Undoubtedly the best equipped yard in Germany at the present time is Krupp's Germania Works, at Kiel, on the Baltic Sea. This plant was established before 1879, but at that time was taken over by a stock company under the name of the Germaniawerft, which also took on the engine works at Egell, near Berlin. Owing to the wide separation of the engine and hull departments, the yard did not pay, and was sold in 1896 to Friedrich Krupp, of Essen. The yard has since been completely remodeled, and now covers about 60½ acres, and employs from 6,000 to 7,000 men in combined hull and engine departments.

The designers were given a free hand when the yard was reconstructed, with the result that a large yard was turned out, with the newest and most complete equipment money could buy, and presumably embodying the best ideas in layout and systems of construction evolved up to that time. The yard is probably the most expensively equipped in the world, and is intended to build anything from a small yacht to the largest transatlantic



GENERAL VIEW OF THE FOUR COVERED SLIPS AT THE GERMANIA WERFT.

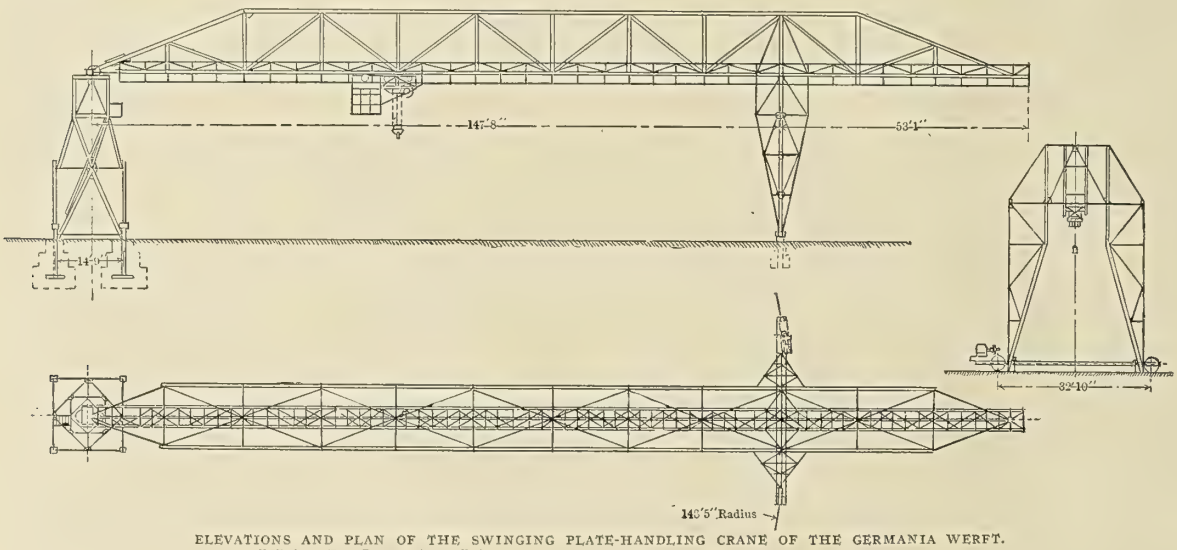


TRANSVERSE SECTION THROUGH FOUR COVERED BUILDING SHEDS OF THE GERMANIA WERFT, AT KIEL.

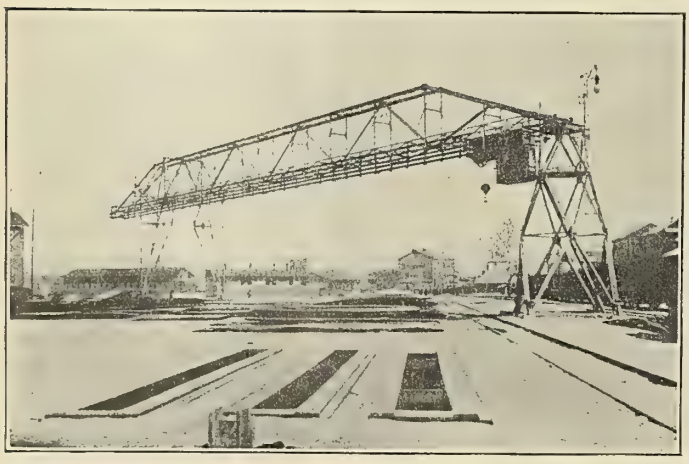
express liner or warship. It is, of course, an open question whether the yard can build ships fast enough, and keep sufficiently supplied with orders, to pay a reasonable return upon the capital invested; also whether the Germans are going to succeed in doing a thing the British firms long ago abandoned; that is, in profitably building vessels of widely varying types, with one equipment.

There are at present seven large slips, with three still larger ones proposed. Four of the present ones are covered by sheds supporting the crane service, and these are completely glassed in. The glass extends to within about 20 feet of the ground on the sides, and gives an extremely light, weather proof shed to work in, though one which must be very expensive to construct and maintain. Every slip is served by four cranes, each of which serves a quarter of the ship, taking material from narrow gage tracks which extend down the sides of the slips under the arched supports of the sheds. The cranes are especially designed with booms on the lifting crabs, in order to overlap on the center lines, so that there is no unreachable zone.

Electric and pneumatic drives are used throughout the yard, which has a unique and one of the best plate yard cranes in existence. The plate yard is approximately semi-circular, and the crane consists of a stationary vertical support, with a horizontal girder, nearly 200 feet in length, swinging around it. One end of this girder is on the stationary, vertical, pin support, and the other is carried by an A-frame support, at right angles to the length of the girder. This A-frame support travels over a semi-circular track concentric with the stationary support, thus swinging the horizontal girder to any radial position over the semi-circular area. The hoisting crab travels along the girder, and so serves any point in the plate yard. The plates are pickled in an acid bath to remove mill scale, washed, and dipped into heavy oil before erection, but this has not proved entirely satisfactory,



ELEVATIONS AND PLAN OF THE SWINGING PLATE-HANDLING CRANE OF THE GERMANIA WERFT.

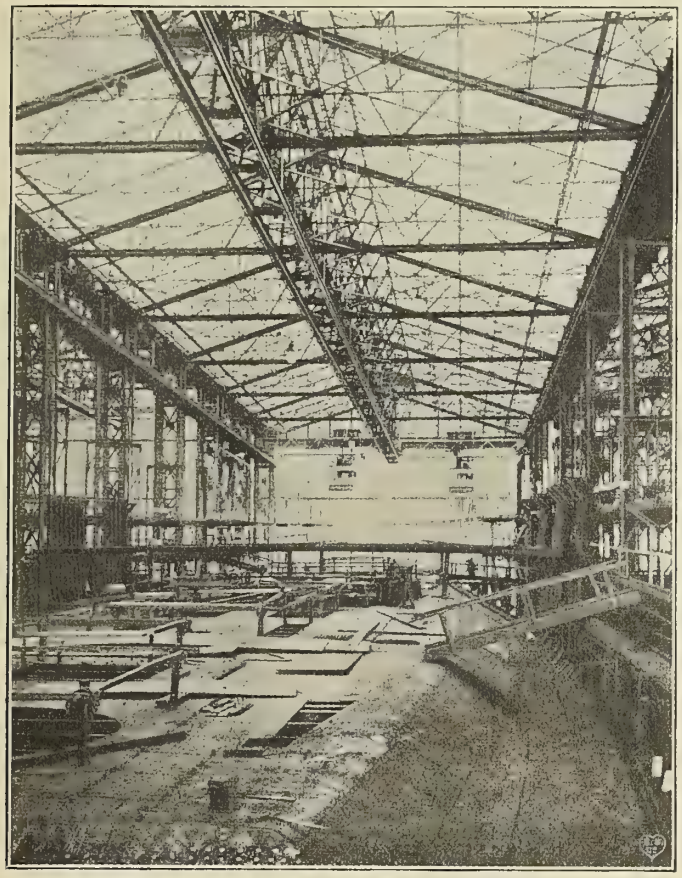


SWINGING PLATE-HANDLING CRANE IN GERMANIA WERFT.

and may be discontinued. Three outfitting cranes, one of the "hammer" type of 150 tons capacity, one of 30 tons, and one of 15 tons, are on the water front.

The hours of labor here differ slightly from those given for the Vulcan works, and are from 7 to 9 and 9.30 to 11.45 a.m., and 12.45 to 5.30 p.m., for the yard. This allows one-half hour for breakfast and one hour for dinner, making a ten-hour day, with no change in hours on Saturdays. The stopping for breakfast is following the British custom, and, as a rule, where the yard does not shut down for breakfast, the men are allowed to take a few minutes individually, to eat the breakfast they have brought—a rather objectionable relaxation of discipline. As in all of Krupp's enterprises, there are model houses, schools, and dining halls connected with the works, and no money has been spared to obtain the best in all lines, perhaps especially noticeable in the technical staff.

There is not the slightest doubt that Germany intends to develop a strong shipbuilding industry within her own boundaries, and to this end the government has aided the shipyards in every



ON THE PROTECTIVE DECK OF THE BATTLESHIP HESSEN, IN SLIP III.

possible way. Large government orders have been placed, all articles necessary for shipbuilding are brought into the country *duty free*, and especially is it manifest in the freightage over railroads. The railroads in Germany are owned and operated by the government, and coal and steel for the shipbuilding companies are carried at the lowest possible rate, which, of course, means a great help to the industry. The contrast between these conditions and those at present existing in America is sufficiently great to need no comment.

THE INFLUENCE OF MACHINERY ON THE GUN POWER OF THE MODERN WARSHIP.*

BY JAMES MCKECHNIE.

THE DIRECT INFLUENCE OF MACHINERY ON GUN POWER.

This second part of the subject has reference to the mechanism required for loading, training, elevating, and firing the gun. Here there is less speculation, but the problems involved and the possibility of differences of opinion make it equally important to have an informing discussion. There should be agreement as to the requirements of the ordnance machinery, but there may not be the same unanimity as to the means adopted to meet the conditions. Rapidity in hitting and wide radius, alike in training and elevation, are the principal conditions to be met. The attainment of these call for extreme precision in movement and control, wide ranges in speed, and absolute reliability in all respects of gun mountings.

This question of reliability must be considered, not only with reference to the possible breakage of parts in action, but also with regard to the choice and design of the prime mover and the mechanism embraced in the comprehensive term "gun mountings." The highest class of material available must be used. We may note the tensile strength of various materials used for gun-mounting machinery and the advance in recent years. Methods of manufacture must be adopted to insure accuracy of gage and template work, and generally a high quality in the resulting products.

Plates and Angles for Gun Slides from 27 or 30 to 35 or 40 tons per square inch.

Steel Forgings (Ordinary).—From 28 to 30 or 35 tons per square inch.

Steel Forgings (High Tensile).—From 32 to 35 or 40 tons per square inch. (All the smaller forgings on the oscillating portion of mounting, which formerly were made of steel having a strength of 28 tons per square inch, are now made of this high tensile material).

High Strength Bronzes.—From 30 to 34 tons per square inch, and 40 tons per square inch for special purposes.

These points, however important, need only be thus hinted at. Of greater interest are the means adopted for insuring precision and wide variation in the rate of speed in training and elevating. The importance of these will be realized when it is remembered

*Read before the Institution of Naval Architects, March 20, 1907.

OUTFITTING CRANE OF 150-TONS CAPACITY IN THE GERMANIA WERFT.

that at five miles' range, a change in the distance of the target of 100 yards means a difference in the position of the muzzle of the gun of only about 0.6 inch in the vertical line, or about 40 minutes in the arc of training.

The gun, as a rule, is mounted so that it is balanced for vertical movement about the trunnions. The frictional resistance to rotation about the trunnion is now further reduced by carrying the weapon on knife edges or ball bearings. For horizontal movement the whole system is carried on a ring of rollers in the case of large guns, and by ball bearings in the case of lighter guns. As the rolling or pitching of the ship throws the plane of the roller path out of the horizontal, the gun must also be balanced about the vertical axis of rotation. It may be incidentally noted that, with these conditions realized, the power necessary to operate the gun is reduced to a minimum. Thus the heaviest weapons can be worked by manual power, although not so rapidly as by mechanical power.

A rapid alteration of range to follow the target, or to compensate for the rolling of the vessel, calls for quick, as well as finely adjusted, movement in elevation. A similar condition applies to the training, where movement must also be exceedingly fine, and at the same time rapid, because when following the movements of a vessel on the skyline, where the angular displacement would be exceedingly small, it must be possible to instantly change the objective point to a vessel at closer range. The angular movement would thus be enormously increased. All these movements are now under the control of the gun-layer, who has in his hand a lever, or in the case of twin-mounted guns two levers, which, moved in a vertical or horizontal plane, separately or concurrently, produce corresponding movement in one or both of the guns. The extent of the movement of the lever in any direction determines the rapidity of the resultant motion of the gun. The charge in the gun is ignited by pressing the trigger of a pistol grip forming the handle of the same lever.

The progress in accuracy and precision of control is indicated by the fact that the mass of 500 tons represented in a modern mounting for two 12-inch guns can be trained at one motion of the valve lever through a distance corresponding to the smallest perceptible movement of the target observed through a telescopic sight.

INCREASED GUN POWER AND HIGHER STRESSES IN MECHANISM.

At the same time, there has been advance in meeting more severe conditions per unit of weight. The naval architect is here, as always, seeking for economy in his displacement tonnage, while the gunnery officers are demanding higher energy from guns of the same caliber. The advance in the power of the gun does not directly come within the scope of this paper, excepting only as it affects the operating machinery. The higher muzzle energy affects the design of gun mountings more than may at first sight appear. The caliber and the weight of the projectile may remain constant; but, as the powder charges are increased and the muzzle energy is augmented, the stresses due to recoil are immensely intensified, especially when the length allowed for taking up recoil is constant. The table shows the advance in power of the gun of 12-inch caliber in 20 years. The muzzle energy per ton of gun in that period has practically doubled.

Year	1886(*a*)	1896	1901	1906
Weight of gun in tons	45	46	50	58
Length of bore (including chamber) in calibers	25·13	35·43	40	45
Weight of charge in pounds	295	167	211	325
Character	Prismatic Brown	Cordite	Cordite	Modified Cordite
Weight of projectile in pounds	714	850	850	850
Muzzle velocity in feet per second	1,910	2,400	2,481	2,900
Muzzle energy in foot tons	18,060	33,940	36,290	47,697
Muzzle energy per ton of gun	420·1	738	726	822
Perforation of wrought iron at muzzle	22·5″	38·5″	39·7″	51″

Compiled from successive volumes of Brassey's *Naval Annual*.
(*a*) 1891 is the same.

Heavier carriages, slides, recoil, and run out and in cylinders are thus necessary. Again, the more powerful gun, being longer, requires a larger turret, larger turntables, and larger barbettes. The class of powder adopted also influences weight; the compounds now used increase the stresses, as compared with those of only a few years ago.

In connection with the weight question a few remarks may be introduced with respect to barbette construction, which, although not altogether within the scope of the paper, may be of interest to the naval constructor and the gunnery expert. There are two methods by which the weight of the barbette may be reduced: (1) by lessening the diameter, and thus proportionately its weight; and (2) by improved methods in the arrangement of its backing and supports. A reduction in diameter might be obtained by altering the design of the mounting, and by doing away with all useless clearance between the mounting and the barbette. In this manner barbettes for a pair of 12-inch guns have been reduced, between 1899 and 1906, from 36 feet 8 inches to 28 feet 8 inches external diameter, although at the same time the guns have been increased in length from 35 to 45 calibers, and in weight from 46 to 58 tons each.

HYDRAULIC VERSUS ELECTRIC POWER.

Attention may be directed to what is perhaps the most important general question affecting the efficiency of the elevating and traversing mechanism, namely, the type of prime mover to be adopted. This affects not only the efficiency and reliability but weight. At various times guns have been operated by steam, air, hydraulic and electric power. The two former are no longer adopted; as to the others, opinion is divided, with the balance perhaps in favor of the hydraulic system. It does not, in the event of the fracture of the supply pipes, involve personal injury or danger; damage is at once visible by leakage and can be easily repaired, whereas breakage of electric leads is not easily located and may involve more trouble. Short circuiting, too, may have serious results on the electric generator or associated gear. Any element of uncertainty resulting from such unknown and undiscovered danger might in action be seriously demoralizing to the personnel. The motion of hydraulic engines and presses is practically silent. They can be worked so slowly that gearing can be dispensed with, a condition not possible with electric driving. In some cases the single-stroke motion of the hydraulic press is more suited to the work than the rotary motion of the electric engine. This is the case, for instance, with the shell hoist, and possibly also with the elevating gear and gun-loading mechanism.

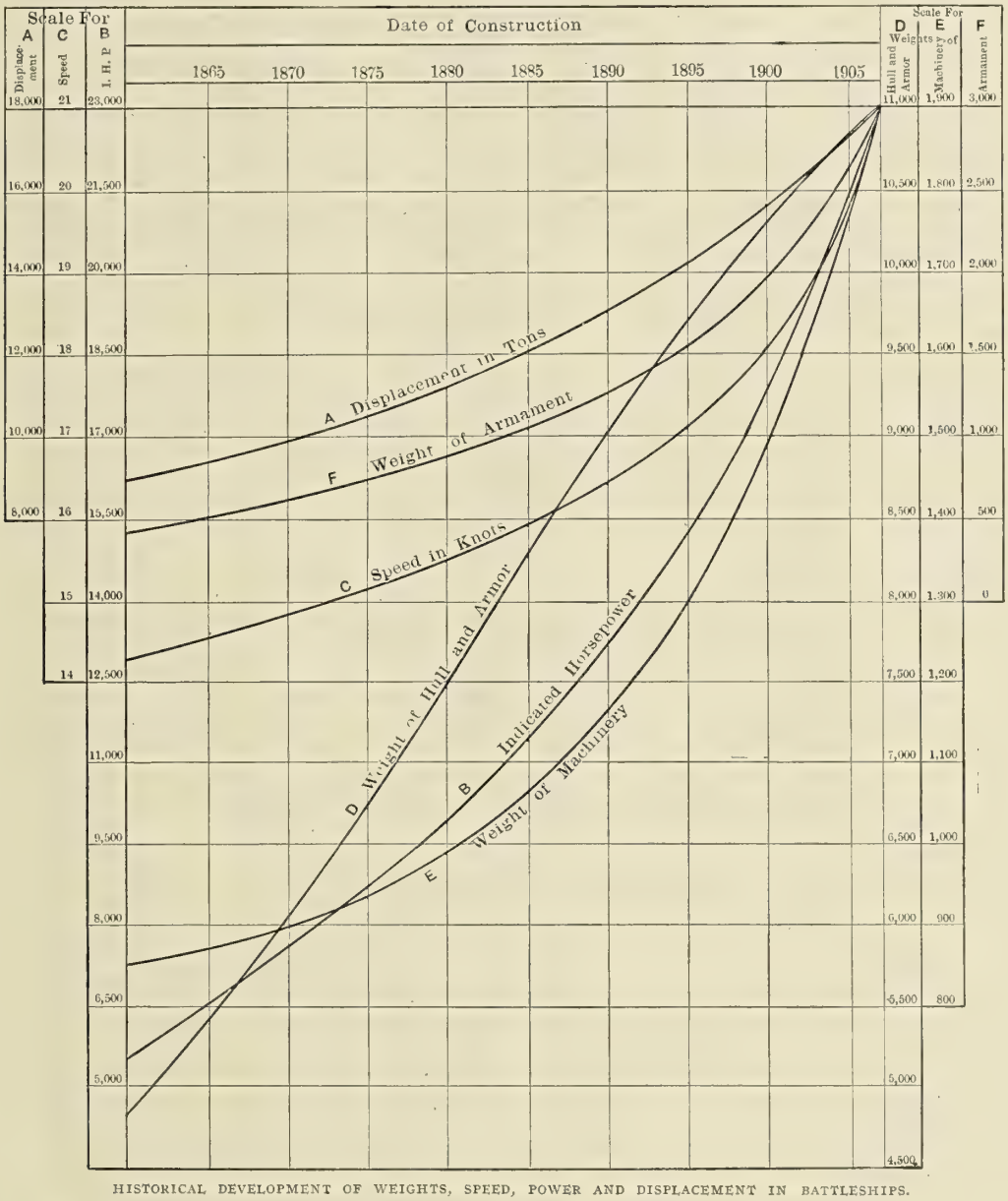
For controlling the gun during recoil, and for running it out after recoil, this single-stroke motion is superior. All guns, from the newest 12-inch breechloader to the quick-firing six-pounder, have their recoil controlled by hydraulic power, generally in the form of independent presses, which are not connected to the pressure system of the ship. For running out the gun to the firing position, the hydraulic system is superior, but other methods are available. Electricity, however, is quite unsuitable, and with electrically operated gun mountings in some foreign ships, a supplementary hydraulic system is occasionally fitted. More frequently springs are used with guns of medium calibers, and occasionally even with guns of 12-inch caliber, having a moving weight up to 65 tons. Compressed air is also adopted occasionally. Both these alternative methods are satisfactory, but each involves additional weight, especially when springs are used. Moreover, springs are not so reliable as the hydraulic press, as they may fracture suddenly. Several columns of springs may be fitted, in which case the breakage of a spring in one column would not affect the run-out of the gun at small angles of elevation, and possibly at all angles, if there were a sufficient reserve of spring power; but the objection exists, and detracts from the

reliability of an essential part of the mechanism. A 12-inch gun recoils a distance of nearly 3 feet, and attains a maximum velocity of over 20 feet per second; it has to be run back to its firing position through this 3 feet in about four seconds, and must be slowed down gently and quickly in the last 3 or 4 inches of its travel. Thus considerable stress is involved.

There are, however, several parts of the mechanism to which the electric system is adaptable, perhaps even preferable; and thus there is in many modern warships a combination of hydraulic and electric power. The latter is more freely applied for special parts, because, current being available, no special generating plant is required. To obtain precision of control, however, it is necessary when using electricity to introduce motor generators for supplying current to the operating motors, so as to be able to vary the voltage at the operating motor terminals. This involves additional weight and complicated electric leads.

For the supply of ammunition to the gun by direct-acting hoists, hydraulic power is most simple and direct. It is extremely light for the load, has few working parts, is very accessible, and is little liable to go wrong. For hoists used in ammunition passages, where a quick, continuous delivery is required, with automatic loading and discharging, either electric or hydraulic power may be used, but the balance of advantage is perhaps with the electric system, everything being carefully considered.

For training heavy gun turrets, hydraulic gear is undoubtedly the simplest and lightest. The same precision of movement, however, can be obtained with electric gear. The usual ratio between maximum and minimum speeds is in both cases about 150 to 1, although a ratio as high as 240 to 1 has been obtained with specially designed hydraulic gear. The same holds good in the case of revolving turrets for smaller guns, but here the question is chiefly one of convenience. If the ship is small, with few guns, electric power is preferred, as all ships have now electric generators, and except for gun work, need not have hydraulic pumps.



HISTORICAL DEVELOPMENT OF WEIGHTS, SPEED, POWER AND DISPLACEMENT IN BATTLESHIPS.

These remarks are generally applicable also to elevating apparatus, where hydraulic power is preferable, and is most accessible for examination and overhaul. Where hand power is used in addition to machinery, the balance of advantage is still with the hydraulic system, as the parts are fewer and lighter.

Electricity is the only possible means of firing the guns, other than by hand. The current for this purpose is transformed to about 15 or 20 volts by a motor generator placed outside the barbette or turret, and is transmitted to the turret by flexible cables. Lanyard percussion gear is, however, always fitted, so that the guns can be fired by hand, should the electric current fail.

RETROSPECTIVE AND PROSPECTIVE.

This review of the present state of progress in the machinery of a warship may prove the basis for future advance; but it will be recognized that in few departments of applied science is greater experience necessary, not only from a mechanical, but also from the fighting point of view, than in the design and manufacture of ordnance machinery. An investigation of the development of the battleship from the ordnance standpoint has enabled a diagram to be prepared showing this progress. The curve marked—

A shows the actual growth of displacement in tons.
B the advance in horsepower of propelling machinery.
C the progress in speed.
D the weight of hull and armor.
E the weight of machinery, and
F the weight of armament, including all guns, with such of their protecting armor as is not attached to the ship.

These curves have been drawn to show the mean results over a period of 47 years; in other words, they strike a mean path among "spots" representing the particulars of the most important battleships of successive years. This has been accepted as a simpler method of indicating advance than by the plotting of a curve, with the irregularities due to the linking up of the spots. It will be seen that the displacement tonnage has doubled in the 47 years; that the indicated horsepower has quadrupled, while the speed has advanced 50 percent. This suggests higher propulsive efficiency alike as regards machinery and form of hull.

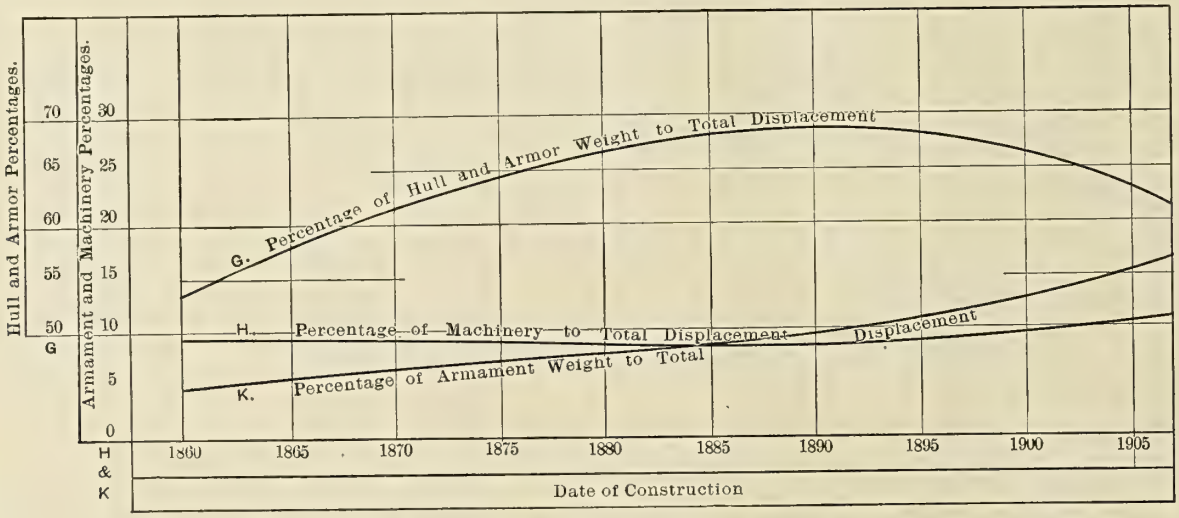
In measuring the relation of the weight of hull, armor, armament, and machinery to the total displacement tonnage of the ship, the only comparative basis seems that of percentage, which is often more or less misleading. This is especially the case when this mode of analysis is applied in comparing particular designs of ships, because the amount and distribution of armament, the arrangement of protective material, the speed required and the coal carried on the normal draft may lead to inaccurate assumptions. In this case, however, we are concerned only with the general trend. There are produced on the diagram three curves, to show the percentage of (*G*) hull and armor, (*H*) machinery, and (*K*) armament, respectively, to the normal displacement tonnage of successive ships since 1860.

In the older types of ironclads, from 1860 to 1870, the weight of hull and armor was smaller in proportion to the displacement than in the ships constructed between 1875 and 1890, but in the more recent vessels the proportion of hull and armor has been again reduced. This latter reduction is probably accounted for by the greater resistance to penetration of modern armor per unit of weight, and to the adoption, in the hull generally, of material stronger per unit of weight.

Of immediate interest is the fairly constant percentage of weight of propelling machinery to the total displacement tonnage, notwithstanding that the total indicated horsepower per ton of displacement has greatly advanced. Thus, at the beginning of the ironclad era, the machinery of the *Warrior* was equal to about 0.60 indicated horsepower per ton displacement, whereas the weight of machinery alone, *i.e.*, excluding coal, was about 9.5 percent of the displacement. In the *Royal Sovereign,* which marked a new era in warship design, the power had increased to about 0.95, and the weight of machinery alone was 9.0 percent. In the *King Edward VII,* which again marked a new departure, the horsepower was about 1.14 per ton, while the proportion of weight was about 10 percent of the total.

It will thus be seen that the marine engineer, notwithstanding the greater demands made upon him for higher power, has assisted the naval architect to keep the displacement tonnage of the ships as low as possible. In other words, the propelling machinery per ton of weight has increased from about 6.3 indicated horsepower in the *Warrior* to about 10.75 in the *King Edward VII,* and about 12.5 horsepower at the present date.

As regards the percentage of weight of armament to the total displacement, shown in curve *K,* there has been a steady increase, but at the same time there has been a much greater advance in the gun power of our ships, so that here especially progress has been most marked. This is particularly the case in recent years. Forty-seven years ago the broadside fire of the newest battleship was made up by four guns of 8-inch caliber and fourteen of 7-inch caliber, but the former were weapons of only 9 tons and the latter of 6½ tons. In the *Devastation* of 1871 the broadside fire was four 12-inch guns. In the *Royal Sovereign,* of twenty years later, it was increased to four guns of 13½-inch caliber, with five 6-inch guns, but in the interval a great advance had been made in gun construction, so that the power of each weapon had greatly increased. In the *King Edward VII* we have as broadside fire four 12-inch guns, two 9.2-inch guns, and five 6-inch guns, while in the *Dreadnought* the broadside fire is eight guns of 12-inch caliber.



THE HISTORICAL DEVELOPMENT OF PERCENTAGES OF CERTAIN WEIGHTS IN BRITISH WARSHIP CONSTRUCTION.

As has been pointed out, however, the bore of the gun affords little indication of its power. The 12-inch gun of to-day has double the muzzle energy of that of 1885. The table shows at a glance the advance in weight of twin gun barbette mountings within the past seventeen years. Since 1900 progress has been most marked. Seventeen years ago the muzzle energy developed by two guns was equal to 373 foot tons per ton of gun mounting, excluding the gun and shield, while to-day this energy is 533 foot tons.

Thus, while doubling the striking power of each gun, the ordnance engineer has not greatly increased the weight, and has

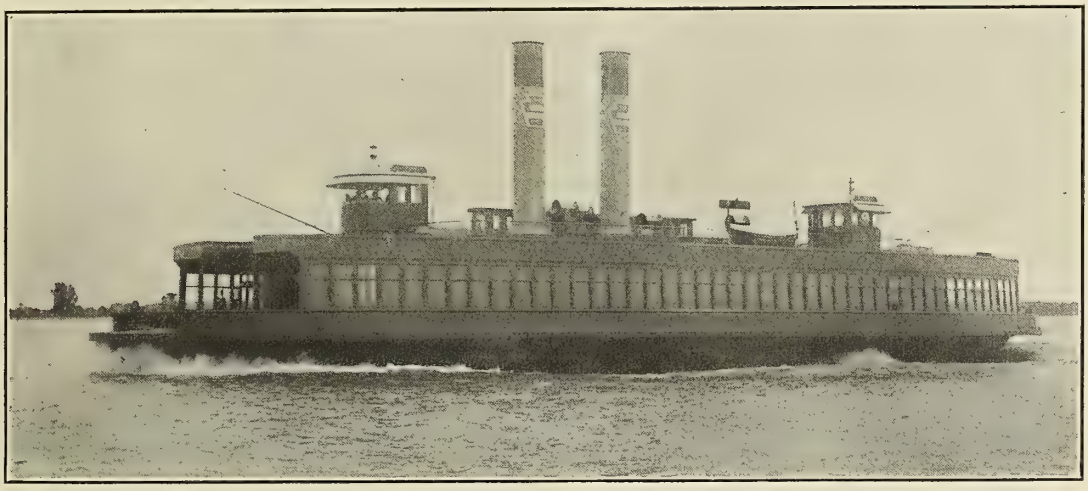
Year	Mountings for Pair 12-inch Guns	Tons	Muzzle Energy: For Two Guns	Muzzle Energy: Per Ton of Mounting	Muzzle Energy: Per Ton Total
			Foot Tons	Foot Tons	Foot Tons
1890	Mounting	177	66,000	373	245
	Shield	—			
	Two guns	92			
		269			
1895	Mounting	171	66,000	386	251
	Shield	—			
	Two guns	92			
		263			
1900	Mounting	202	66,000	327	158
	Shield	124			
	Two guns	92			
		418			
1905	Mounting	211	76,000	360	162
	Shield	158			
	Two guns	100			
		469			
1907	Mounting	209	88,000	420	172
	Shield	186			
	Two guns	116			
		511			
Building	Mounting	210	112,000	533	210
	Shield	194			
	Two guns	131			
		535			

THE LONG ISLAND FERRY-BOAT HEMPSTEAD.

There have been placed recently in service on the ferry between Long Island City and Thirty-fourth street, New York, two ferry-boats named *Babylon* and *Hempstead*. These were built for the Long Island Railroad Company by the Harlan & Hollingsworth Corporation, of Wilmington, Del., and have a length on the waterline of 188 feet 5 inches; a length over all of 203 feet; an extreme breadth molded of 45 feet 1 inch; a breadth over guards of 65 feet, and a depth of 16 feet 5 inches. The gross tonnage is 1,310, and net 890.

In general design they are similar to the type of vessel in use by the Pennsylvania Railroad. The hull is subdivided by means of seven transverse watertight bulkheads and two longitudinal bulkheads, the total subdivision being into twenty watertight compartments. Each transverse subdivision is provided with a steam siphon operated from the engine room. All of the machinery for pumping purposes has been confined to the engine room space. There are no openings in the compartments except at the deck line, and each such opening is protected by a watertight door. This arrangement provides the maximum amount of safety in case a compartment should be punctured.

The hull is of the straight keel type, with a bar keel and with balanced rudders at each end. The hull, decks, center housing, side walls of the wagon gangways and inside walls of the cabins, including the ceiling, are all of steel, thus providing splendid protection against fire. The outside walls of the cabins are of wood, sheathed on the inside with metal. This arrangement was fitted because of the fact that in the event of collision it can be more readily re-installed than can sheet steel, and at a less cost. In addition to this fireproof construction, a complete fire fighting system has been installed, with large fire pumps, capable of throwing 500 gallons per minute.



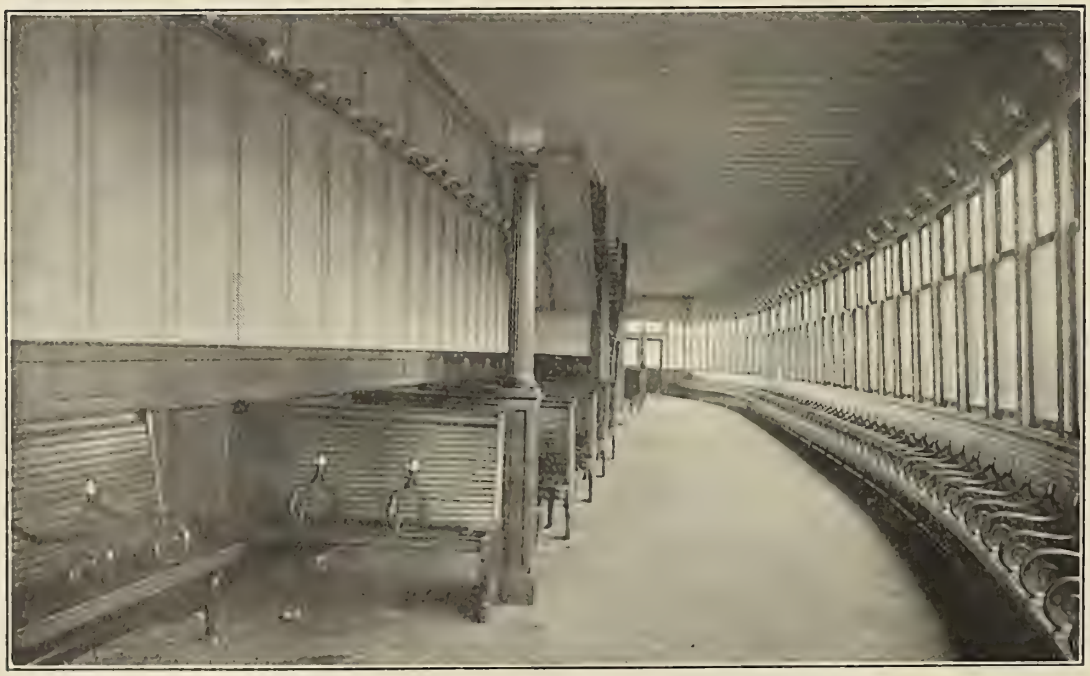
THE LONG ISLAND FERRY-BOAT HEMPSTEAD STEAMING AT 16.2 MILES PER HOUR.

The two propellers, one at each end, are operated on a single line of shafting by means of two compound engines, each of which has cylinders measuring 18 and 38 inches in diameter, with a stroke of 28 inches. The cranks of each engine are set 180 degrees apart, while those of the one engine are set at 90 degrees from those of the other. The engines are piped independently from a common steam system, so that in case of necessity either one can be used alone. They are provided with independent condensers, air, circulating and feed pumps. The water from the hot well is forced through a feed water heater before it enters the boilers. The latter are of the watertube type, built by the Almy Watertube Boiler Company, of Providence, R. I., and consist of four units in groups of two. They are place fore and aft, with a central fire room. Each set of boilers has an independent stack. The total grate surface consists of 216 square feet. The heating surface is 8,000 square feet,

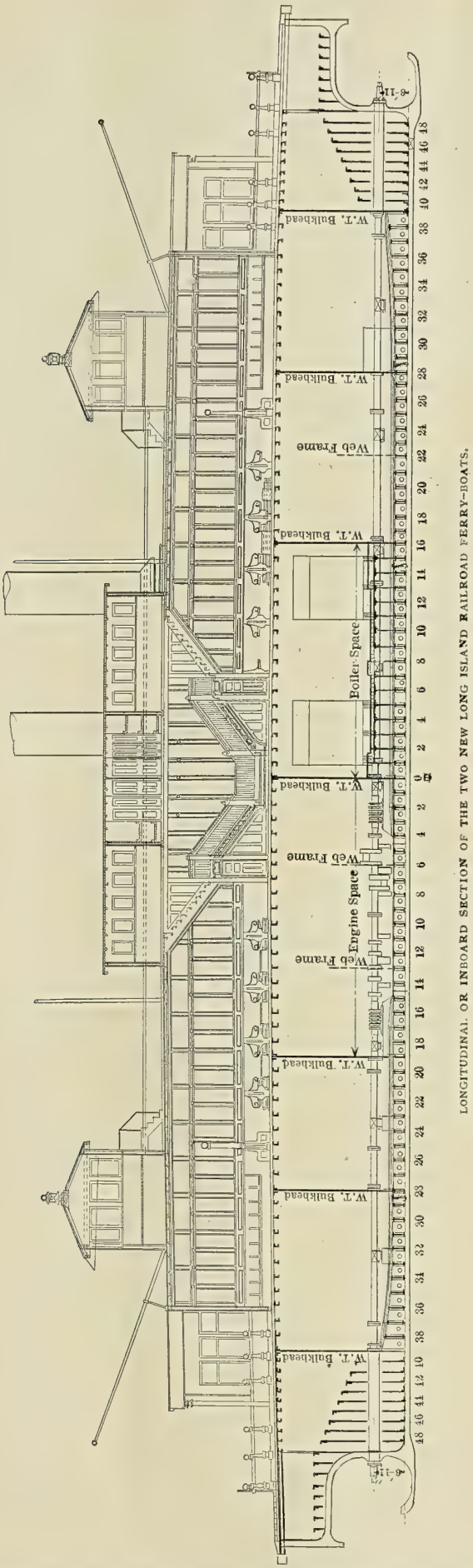
simplified and improved each unit in the mechanism, to insure more accurate control of the gun, a greater rate of fire, and fuller reliability. Beyond this there is the still more important fact that while encouraging improvement in material, there has been brought about a great advance in the percentage of hits within a given time by perfecting the system of fire control, thus adding enormously to the influence of modern machinery upon the fighting efficiency of warships.

Shipbuilding in Germany during 1906 showed a marked increase over 1905, the gross registered tonnage of merchant vessels constructed, including ocean steamers, sailing vessels, river steamers, etc., having been 367,820 tons, as against 277,731 tons in the previous year. This represents an increase for the year of 32.4 percent. The tonnage of war vessels constructed fell off from 30,630 to 23,671. At the close of the year 1906 there were under construction merchant vessels of various types aggregating 323,244 tons, and war vessels of a total of 72,444 tons.

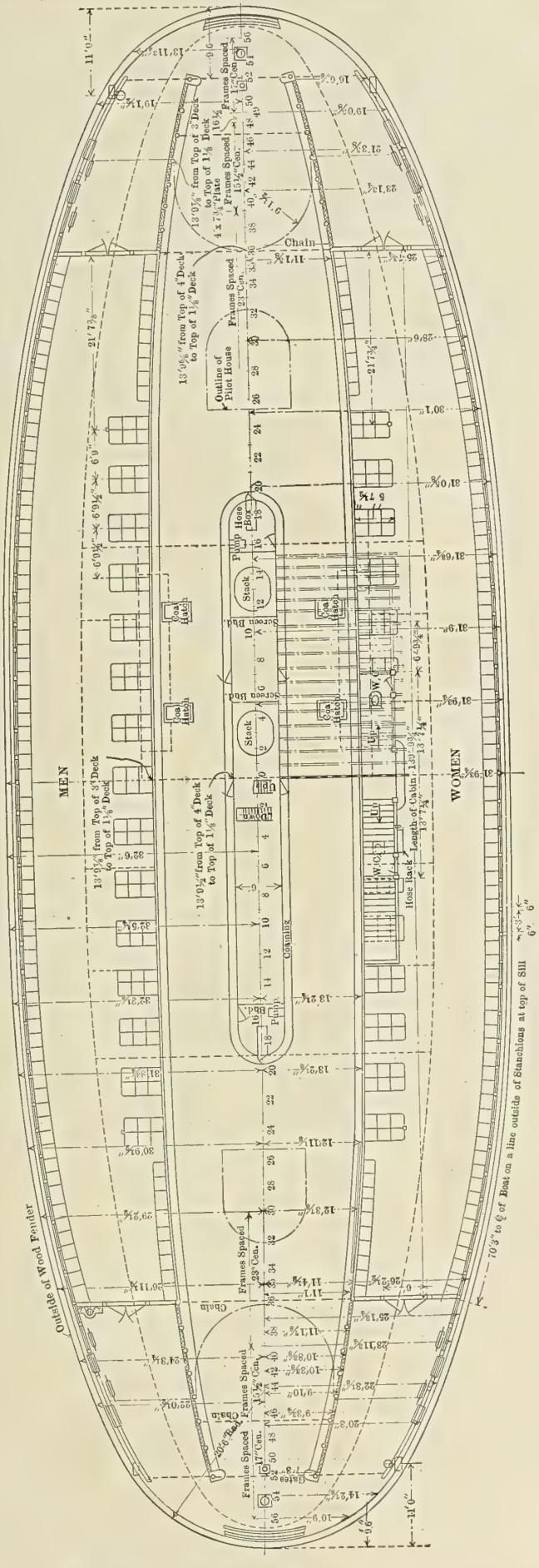
LOOKING FORWARD FROM AFTER END OF UPPER DECK, FERRY BOAT HEMPSTEAD.



THE LADIES' CABIN ON THE LONG ISLAND FERRY-BOAT HEMPSTEAD.



LONGITUDINAL OR INBOARD SECTION OF THE TWO NEW LONG ISLAND RAILROAD FERRY-BOATS.



MAIN DECK PLAN OF THE LONG ISLAND RAILROAD FERRY-BOATS BABYLON AND HEMPSTEAD, SHOWING CONTOUR OFFSETS.

giving a ratio of 37 to 1. These boilers are provided each with independent injectors and feed pumps and feed water regulators.

The system of ventilating is very simply worked out, but is reported to be very efficient. It has been so designed as to give

two up-drafts and one down-draft, the latter occurring in the center of the boiler room, thus providing continually in the fire room a fresh current of air. This is accomplished by means of two divisional bulkheads in the boiler casing, each of which goes down to a point just a few inches over the front of the boiler. It is evident that the two compartments directly above the boilers will be filled with heated air from the boilers, and will act in a measure as chimneys, carrying this heated air out of the boiler room. To make up the deficiency, cold air must enter from above, and will naturally do so through the center compartment, which opens over the fire room between the boilers. This artificial "natural" draft has been found to work beautifully, and its greatest merit is its extreme simplicity.

The propellers are cast steel in one piece, and have a diameter of 9 feet. Those fitted on the *Babylon* have a pitch of 12 feet, making the pitch ratio 1.333; while those on the *Hempstead,* with a pitch ratio of 1.278, have a pitch of 11 feet 6 inches. On trial trip, the propellers ran at about 140 revolutions per minute. The steering gear has been supplied by the W. D. Forbes Company, of Hoboken, N. J. This particular type was adopted because the ship was such as to permit of its being used above deck, the end of the center house being utilized as a foundation. This also permits all oiling of machinery and steering gear to be done above decks. The electrical equipment includes two generators, one of 7½ kilowatts and the other of 15 kilowatts. The smaller one is used for the day circuit and for emergency purposes, while the larger one is turned on at night.

The equipment of life saving apparatus is nearly double that required by the Supervising Inspectors of Steam Vessels, including, as it does, two lifeboats and four life rafts. Adequate provision is made in the shape of life preservers, buckets, axes and fire extinguishers.

The cabins are equipped with lights placed on a line with the top of the windows, and it is said that the effect is very pleasing. The seats are placed transversely in sections of six each, giving a slight increase in the seating capacity of the boat. The cabin floors and stairways leading to the upper deck are covered with interlocking rubber tiling. The top lights in the cabins have been so formed as to give unobstructed light to the entire horizon, thus making the lamps more accessible and permitting their being easily cleaned and renewed.

The upper deck has been arranged so as to form a promenade, with stairways leading from the ladies' cabin, and is similar to those on double-deck ferry-boats, except that there is no covering upon it. It can, therefore, be used only in clear weather, performing a function similar to promenade decks on steamers. No fixed seats are used on this deck, but an equipment of camp stools has been provided. This deck is constructed with the idea of supporting an upper cabin, should it be deemed desirable to provide it later.

On trial trip the *Hempstead* made under slack water conditions 16.6 miles per hour, as compared with a contract requirement of 15 miles.

French Subsidies.

For the year 1907 postal subsidies for French steamers have been allotted as follows:

To Corsica	$104,700	£21,500
To the Mediterranean lines	257,300	52,900
Between Calais and Dover	47,600	9,800
To New York and the Antilles	2,108,000*	433,500
To Indo China and Japan	1,185,000	243,800
To Algeria and Tunis, etc.	276,000*	56,700
To Australia and New Caledonia	615,000	126,500
To East Africa and the Indian Ocean	356,000	73,200
To West Africa	95,400	19,600
Total	$5,045,000	£1,037,500

*Including premium for speed.

TORQUE OF PROPELLER SHAFTING: SOME INVESTIGATIONS AND RESULTS.*

BY J. H. GIBSON.

The necessity of ascertaining the horsepower of a marine steam turbine by some means analogous to the indicator has revived interest in the torsion-meter as applied to propeller shafting. Indicated horsepower as obtained by mean pressure diagrams from a reciprocating engine is all very well from the naval architect's point of view, so long as frictional and other losses are known and remain fairly constant; but the actual power transmitted to the propeller by the shaft is more definitely valuable information, if such is obtainable and can be relied upon.

In utilizing a steel bar such as a propeller shaft for the measurement of power, obviously the first thing to do is to "calibrate" that portion of the shafting which is to be so utilized. For the shaft behaves exactly like a steel spring. However accurate the dimensions and homogeneous the material, there are slight differences from the calculated results that must be known; just as there are discrepancies in a set of apparently identical helical springs for boiler safety valves. Each must be tested and set independently. And the analogy suggests that shafts used for torsion-meter records should be re-calibrated periodically, just as safety valve springs are.

A screw propeller shaft when transmitting power undergoes a compound strain. Not only is it twisted by the engine; it is simultaneously compressed by the thrust of the propeller. That this thrust is not an entirely negligible quantity may be inferred from the fact that in an actual case, the torsional stress in the shafting at full power being 5,100 pounds, the compressive stress due to thrust works out at 950 pounds per square inch, or 18 percent of that due to torque alone. In calibrating the shafting, then, it is advisable to make an allowance for, or to imitate as far as practicable, the actual working conditions, and to fix the power constant accordingly.

The investigation shows by calculation the probable effect of the compound stress referred to; but it is given with all reserve, as actual experiments do not show quite so marked an effect. This is probably due to the fact that, even when transmitting full power, a propeller shaft is rarely twisted more than 1 degree in 10 feet, and the effect of compression will naturally be more and more marked as the twist increases.

Thus a minute square on the surface of a shaft will become skewed and form a rhombus as the shaft twists, and the square will be pushed out of shape more easily by axial compression as the shaft goes on twisting. It follows also that the effect of compression will be more marked in a hollow shaft than in a solid shaft; and in a shaft having a very large hole than in one of smaller bore; for the skewing effect becomes greater as the surface of the shaft is approached, while the core remains comparatively unaffected by the torque, and offers an unimpaired resistance to compression.

CALIBRATION.

An actual calibration experiment was carried out in accordance with these ideas. The shaft measured 20 feet 6 inches between pointers, and had external and internal diameters of 7½ and 3⅝ inches respectively. The steel showed a tensile strength of 29 tons per square inch, and an elongation of 40 percent in 2 inches.

The torque and compression were calculated beforehand for the varying speeds, allowing 95 percent of the estimated equivalent indicated horsepower for torque, and assuming 65 percent of the same to be re-transmitted from the propeller to the vessel in the form of thrust. In other words, the turbine efficiency was taken as 95 percent, and the propulsive efficiency as 65 percent, giving a propeller loss of 30 percent. The torque was thus given, in pound-feet, as $\frac{0.95 \times \text{I.H.P.} \times 33{,}000}{\text{R.P.M.} \times 2\pi}$; and the thrust, in

*Read before the Institution of Naval Architects, March 21, 1907.

pounds, as $\frac{0.65 \times \text{I.H.P.} \times 33{,}000}{101.3 \times \text{speed in knots}}$. The figures are necessarily somewhat arbitrary, but sufficiently near for the purpose.

Two light pointers were secured to the shaft at a certain fixed distance apart, and of such a length that their points described 1 inch of arc for 1 degree of torque. The torque could thus be readily measured by a fitter's decimally divided straight-edge. The difference between the pointer readings gave the exact torque. It is worth notice that, however secure the fast end of the shaft may be made, there is always the liability of some movement, especially at the beginning of an experiment, due to fastenings, such as bolts, keys, etc., giving slightly as the stress comes on.

The torque was applied by spring balances at opposite ends of a couple, to eliminate friction in the supporting bearing; while the shaft was compressed by means of a 6 to 1 bell-crank lever loaded by weights on a steelyard. To enable the end of the shaft to turn freely, a ball bearing was introduced between it and the compression lever. The loads were applied as follows:

1. First increment of torque.
2. Corresponding increment of compression.
3. Adjust torque balances.
4. Second increment of torque.
5. Second increment of compression.
6. Adjust torque balances. And so on.

An appreciable time was allowed between successive increments for the shaft to accommodate itself to the stress. The loads were taken off in inverse order.

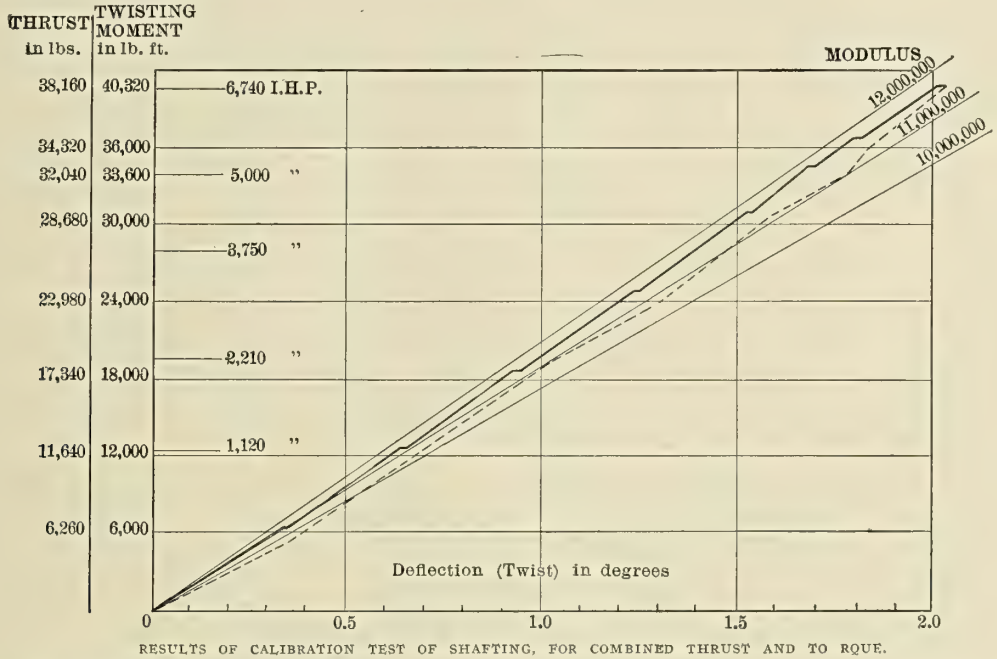
The effect of adding the compression each time was not to increase the angle of torque sensibly and directly, as might be expected, but to slightly relieve the loads on the torque balances. When, however, the torque balances were screwed up again and adjusted to their former load, the shaft was found to be twisted an additional amount represented by the short horizontal lines on the curve, and these horizontal lines became appreciably longer as the full load was attained. The phenomenon of mechanical hysteresis or "lag" was very marked on the return curve; but on the removal of the last increment of load the pointer immediately returned to zero.

As a check the experiment was repeated several times with variations, such as applying the loads quickly, and taking off the total load suddenly; but the curves followed the same lines within narrow limits, and the shaft invariably and instantly returned to zero; thus proving its perfect elasticity, but leaving some doubt in one's mind as to the real nature of the "lag" referred to. Apparently a higher modulus should be taken for a shaft in which the power is gradually and uniformly augmented; and a lower modulus as the power is gradually and uniformly reduced.

But these conditions do not obtain in actual work. A constant fluctuation of load giving rise to torsional oscillations in the shaft occurs, which probably has the effect of harmonizing the maximum and minimum torque for any given power; and the true modulus might be taken as a mean between the upward and downward curves. In the present case the average modulus is 11,250,000, giving a constant of 3.27 in the horsepower formula.

Thus: $$H = \frac{\theta\, D^4\, N}{C\, L}$$ for solid shafting,

and $$H = \frac{\theta\, (D^4 - d^4)\, N}{C\, L}$$ for hollow shafting,



RESULTS OF CALIBRATION TEST OF SHAFTING, FOR COMBINED THRUST AND TO RQUE.

where

H = Shaft horsepower.
θ = Angle of torsion in degrees.
D = Diameter of shaft in inches.
d = Diameter of hole in shaft in inches.
N = Number of revolutions per minute.
C = 3.27 (corresponding to a modulus of rigidity of 11,250,000).
L = Length of shaft in inches.

The formula is such that for a shaft of given diameter, length, and ascertained elasticity, a diagram can be readily constructed to enable the power to be read off at a glance when the revolutions and angle of torque are known. The revolutions are easily obtainable by counter or tachometer, and it remains only to ascertain the torque. The diagram shown is for a shaft 18 feet 7½ inches long and 7¼ inches in diameter, with a modulus of elasticity represented by 12,000,000.

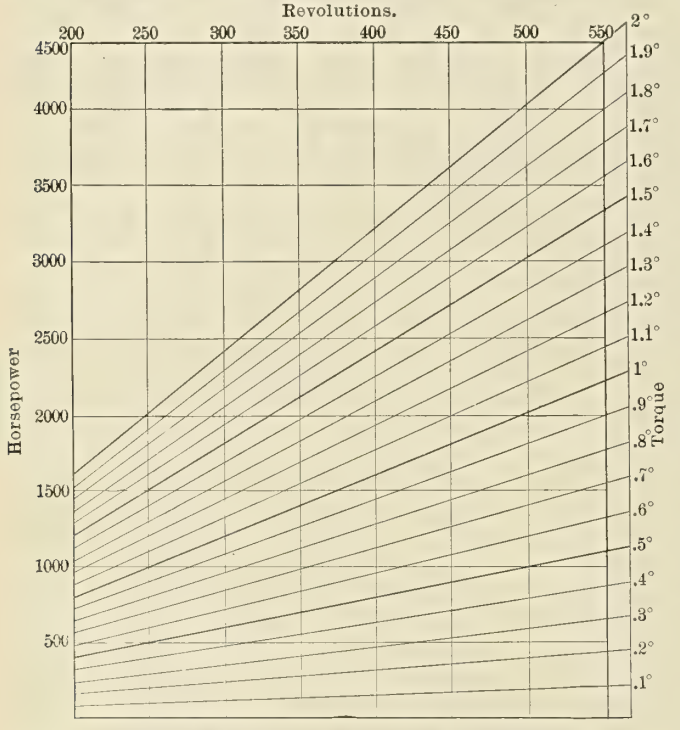
TORSION METERS.

There are two well known methods in use for measuring the torque of a revolving shaft, one electrical, the other mechanical. An example of the former method is the Denny-Johnson torsion meter. The mechanical method is represented by the Föttinger apparatus. It is not proposed to refer to these methods any further than to say that both involve certain intermediate links

between the shaft under observation and the recording instrument, and that such links are liable, under varying conditions, to introduce errors.

The apparatus now to be considered abolishes these intermediate links, and measures the torsion directly from the shaft itself. As a beam of light is the essential feature of the apparatus, it has been called the "flashlight" torsion-meter, and will be so referred to in the following description. The intrinsic parts of the flashlight torsion-meter consist of two thin disks secured to the shaft at opposite ends, and revolving with it a fixed lamp at one end, and a movable "torque finder" at the other.

The disks are similar, and each is perforated near its periphery by a small radial slot. The lamp has a mask perforated with a similar slot, and the torque finder has an eye piece which can be moved circumferentially, and is also provided with a slot similar to the others. When the four slots are in the same radial plane an observer looking through the eye piece can see the beam from the lamp, and at every revolution of the shaft a flash is seen. The faster the shaft revolves the steadier the light appears, owing to the physical effect of persistence on the retina. The apparatus forms, in fact, a pair of photographic shutters, one shutter being at the lamp end and the other at the torque finder end.



CALCULATED CURVES FROM RESULTS OF CALIBRATION.

Immediately the shaft begins to transmit power, the disks twist relatively to one another, and their slots are not now contained in the same radial plane. The beam still flashes through the shutter at the lamp end, but is obstructed at the torque finder because of the relative displacement of the disks. To pick up the flash again it is necessary to move the eye piece circumferentially by an amount equal to this displacement. Attached to the eye piece is a vernier which moves over a fixed graduated scale on the torque finder, and enables the angle of torsion to be read off in degrees.

The width of the slots is eliminated by utilizing their edges and noting carefully the exact instant that the last ray is cut off as the eye piece is moved over. This gives an infinitesimally fine radial line of light as datum, and enables the torque to be measured to 1/100 of a degree, or 1/36,000 of the circumference. No difficulty is experienced in attaining this degree of accuracy. Three independent observers have on occasion obtained exactly the same reading on setting the torque finder for themselves, an operation which takes only a few seconds to perform.

We will suppose that the shaft is revolving idly. The propeller is disconnected; or, if in a turbine vessel, the steam supply may be shut off for a few moments and the turbine opened to the condenser vacuum. The "way" of the vessel will then cause the propeller to revolve the shafting and turbine without appreciable torque. By moving the torque finder over until the flash is just cut off we obtain the "zero" reading, which must, of course, be subtracted from any subsequent power readings. The zero in this case is, say, 0.56 degree. Now, we will suppose that the shaft is transmitting power, and has twisted the disks relatively to one another, thus obscuring the light. To pick up the flash again, the torque finder eye piece, with its vernier, must follow the slot in its corresponding disk, and to get the exact angle of torque the point of cutoff is located as before. The vernier scale now shows 2.45 degrees, which, when the zero reading is subtracted, gives an effective torque of 1.89 degrees. To obtain the horsepower, we refer to a power diagram similar to that shown. Assuming that we know the revolutions to be 500 per minute, then in this case the horsepower is seen to be 3,820.

In the table are set out in progressive form some shaft horsepowers recently obtained on a turbine steamer by means of the flashlight torsion-meter. The results extend over a series of trials carried out under varying conditions, the total powers recorded ranging from 7,975 down to 37. It will be seen that the port low-pressure turbine indicates less power than the starboard, throughout the series. On investigation it was found that the blade tip clearances differed slightly, the percentage difference corresponding almost exactly with the percentage difference of the powers.

In a turbine installation the turning moment is so uniform that it is perhaps necessary to indicate the torque at only one point of the revolution. But in shafting driven by reciprocating engines the turning moment is anything but uniform, and a torque reading taken at only one point in the revolution might give an entirely misleading result. The torque should be ascertained at several points in the circle, and plotted out on a development of the circumference to obtain the mean turning moment.

To meet this condition the flashlight torsion-meter is slightly modified. Instead of having only one slot at a fixed radius, each disk is perforated with several slots, corresponding to the number of points in the revolution at which it is desired to ascertain the torque, the slots being disposed in the form of a spiral at varying radii. The outermost slot, for instance, may indicate the torque when the high-pressure crank is on its top center, and so on. The light and the eye piece of the torque finder must be moved radially to or from the shaft to come opposite each pair of slots in the disks, and observations made for each position as before described.

A torsion-meter record taken from a reciprocating engine shaft by this method, and a set of indicator diagrams obtained simultaneously from the engine, would provide an interesting means of comparison, and very shortly such a comparison may be available. Of perhaps greater interest would be a comparison between the torsion-meter records of two identical vessels run at the same speed, one of which is propelled by turbines, the other by reciprocating engines; as, for example, in the Cunard liners *Carmania* and *Caronia*, or H. M. S. *Amethyst* and *Topaze*. We should then have the exact power transmitted to the propellers of each vessel respectively, the only disturbing element in an exact comparison being the vexed question of propeller efficiency. But a consideration of the compound stresses in propeller shafting suggests that this problem might be solved by the use of some simple apparatus that would record the actual thrust along the line of shafting, and enable a direct comparison to be instituted between the power transmitted to the propeller, and the thrust produced by it.

INVESTIGATION FOR TORSION TEST OF SHAFTING.

Shaft, 7½ inches external diameter, 3⅝ inches hole; length between pointers, 20 feet 6 inches; horsepower, 5,000; revolutions per minute, 750; speed, 33 knots.

Maximum deflection in degrees

$$= \frac{H.P. \times C \times L}{(D^4 - d^4) \times \text{revs.}} = \frac{5{,}000 \times 0.95 \times 3.27 \times 246}{2{,}997 \times 750} = 1.7°$$

$$\text{and maximum thrust} = \frac{0.65 \times 5{,}000 \times 33{,}000}{33 \times 101.3 \times 2{,}240} = 14.3 \text{ tons.}$$

Area of shaft = 33.7 sq. in., and $\frac{14.3 \times 2{,}240}{33.7}$ = 950 pounds per square inch, compressive stress.

Torsional (or shear) stress at full power—

$$\text{T. M.} = \frac{33{,}000 \times 0.95 \times 5{,}000}{750 \times 2\pi} = 33{,}300 \text{ lbs. at 1' radius.}$$

$$\text{T. M.} = 0.196 \left(\frac{D^4 - d^4}{D}\right) f; \text{ therefore } f = \frac{33{,}300 \times 12 \times 7.5}{0.196 \times 2{,}997} =$$

5,100 pounds per square inch torsional stress.

A shear stress produces equal tension and compression stresses at 45°, *i.e.*, $f_s = f_t = f_c$. (Lineham.)

But the compressive stress due to propeller thrust augments the f_c by $\frac{950}{\sqrt{2}}$ = 670 pounds per square inch.

and as $f_s = f_c$, therefore 670 must be added to the 5,100, giving 5,770 = total f_s, = gross torsional (or shear) stress; and 670 = 11½ percent of 5,770.

But the above applies only to the outer skin of the shaft, where the twisting stress is a maximum. The twisting stress at the center is *nil*, while the compressive stress is uniformly distributed over the whole area of section. Therefore the effect of compression in weakening the shaft's resistance to torsion will be *less* than the percentage above quoted.

If the effect at the surface is 11½ percent, and at the core *nil*, we may assume a mean effect over the whole section to be ½ of 11½ percent, or 5¾ percent for a solid shaft; and ¾ of 11½ percent, for the shaft in question, or 8.6 percent for a hollow shaft of normal proportions. The true modulus of rigidity for calculating power would then be 8.6 percent less than the modulus for torsion alone. Actual experiments, however, show only about half of this effect.

FLASHLIGHT TORSION METER—TURBINE STEAMER.

Actual readings and corresponding horsepowers taken during trial trips under varying conditions of displacement and propellers.

Turbine shaft.	Degrees torque.	Revolutions per minute.	Shaft horsepower.
Starboard, L. P.	1.43	482.9	2,775
Center H. P.	1.69	461.2	2,600
Port L. P.	1.37	472.8	2,600
Total			7,975
Starboard L. P.	1.31	461.2	2,410
Center H. P.	1.65	426.8	2,330
Port L. P.	1.24	457.3	2,200
Total			6,940
Starboard L. P.	1.15	426.4	1,970
Center H. P.	1.51	417.6	2,080
Port L. P.	1.13	418.9	1,910
Total			5,960
Starboard L. P.	1.05	418.4	1,765
Center H. P.	1.52	422.3	2,120
Port L. P.	1.02	415.5	1,670
Total			5,555
Starboard L. P.	0.21	198.6	162
Center H. P.	0.27	206.3	185
Port L. P.	0.19	183.5	148
Total			495
Starboard L. P.	0.22	146.7	88
Center H. P.	0.21	171.4	87
Port L. P.	0.13	144.8	82
Total			257
Starboard L. P.	0.07	46.3	13
Center H. P.	0.05	86.1	15
Port L. P.	0.01	24.4	9.2
Total			37.2

STERN OF THE OGASAWARA MARU, SHOWING PAYING OUT GEAR.

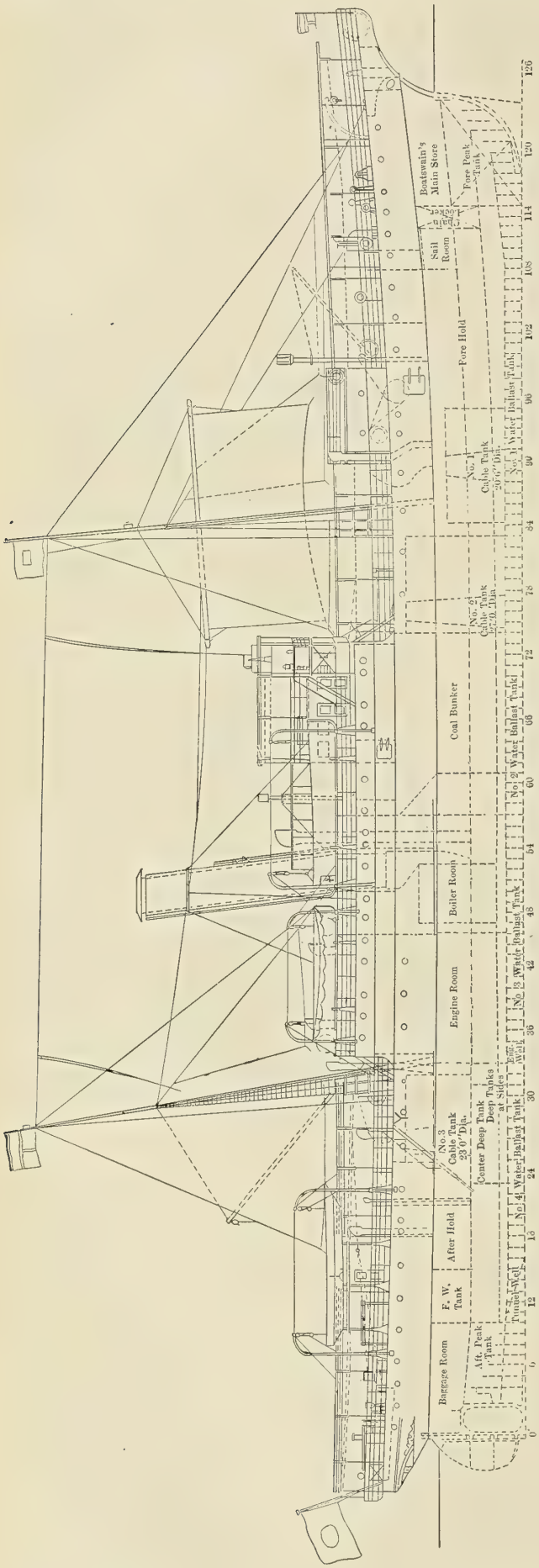
THE CABLE STEAMER OGASAWARA MARU.

BY S. OI.

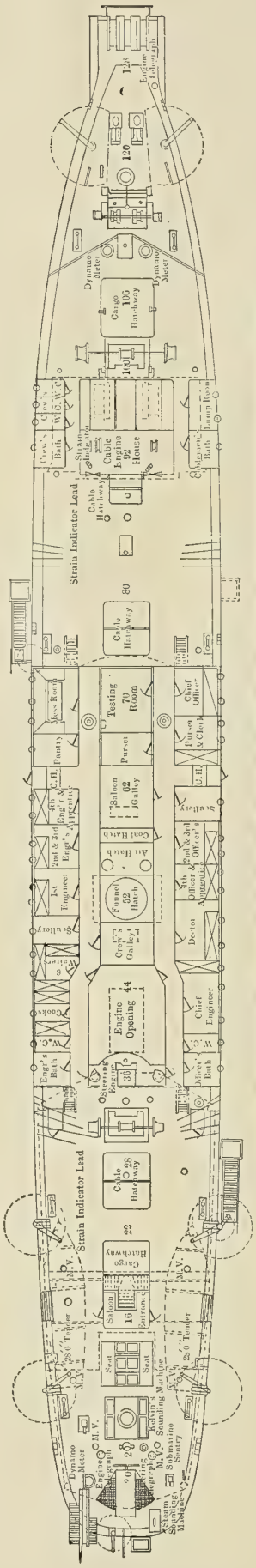
This steamer left Nagasaki on October 5, 1906, for the cable laying work between Tsushima and Kiushiu, and is the first ship of its class built in Japan. The steamer is owned by the Department of Communications of the Japanese government, and was constructed at the Mitsubishi dockyard and engine works, at Nagasaki. The design of the vessel was intrusted to Dr. C. Shiba and Mr. K. Suyehiro, professors of the Engineering College of the Imperial University of Tokio; the contract was placed June 1, 1905, and the work commenced late in November of the same year; the vessel was launched June 2, 1906, six months after the laying of the keel.

She is a steel spar-decked twin screw steamer of 1,455 tons gross, with engines developing 1,850 indicated horsepower at full speed. The hull and machinery were constructed under the Japanese government's shipbuilding encouragement law. The general features of the ship are shown by the profile and plans of the three decks. The principal dimensions of the vessel are:

Length between perpendiculars ..... 240 feet 0 inches



OUTBOARD AND INBOARD PROFILE OF THE JAPANESE CABLE LAYING STEAMER OGASAWARA MARU, BUILT IN JAPAN.



PLAN OF THE GENERAL ARRANGEMENT ON THE SPAR DECK OF THE JAPANESE CABLE STEAMER OGASAWARA MARU.

PLAN SHOWING THE GENERAL ARRANGEMENT OF THE MAIN DECK OF THE OGASAWARA MARU.

Breadth, molded ..... 34 feet 0 inches
Depth ..... 22 feet 3 inches

The guaranteed speed was 12 knots, the ordinary sea speed expected being 11 knots. During the official speed trials, the

maximum speed obtained was 13.286 knots, and the average of six runs between the two measured mile posts, three nautical miles apart, was 13.85 knots.

The hull and machinery of the vessel were all constructed by the Mitsubishi Company, except the cable gear, which was supplied from England by Johnson, Phillip & Company, of Charlton, Kent. Three cable tanks are provided in the vessel, one fore tank of 20 feet 6 inches diameter intended for the storage of shore-end cables, a main tank 27 feet in diameter, and one after tank of 23 feet diameter. The total capacity of the three tanks gives storage for 600 tons in all of deep-sea cables. Each tank is provided with flask cone at the center for storing battens or fresh water. The hatchways of the tanks are provided with girders, carrying bellmouth, crinolines, etc.

The structural arrangements provide two complete decks running fore and aft, and an inner bottom carried nearly the whole length of the vessel, a part of the structure necessary in this class of vessels. The hull is subdivided into five watertight compartments by transverse bulkheads. There are two cargo hatchways, one in front of the cable gear house, and the other in front of the saloon entrance. The hold at the fore hatchway, provided with a wooden platform, forms the cable store; the after hold is for general cargo and provisions.

The foremost cable tank, being provided for the shore-end cables, is carried up to the level of the main deck. The main tank is brought five feet above the main deck, leaving ample clearance between the top edge of the tank and lower side of the deck above. The bottoms of these tanks rest on the top of the inner bottom plating. The after tank is similarly constructed to the main tank, the bottom, however, resting on the top of the shaft tunnel.

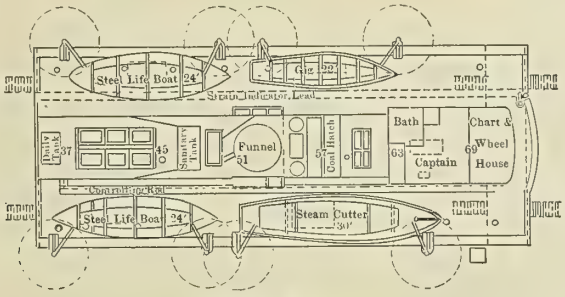
The vessel is rigged as a two-masted schooner. Besides the necessary cargo appliances, the fore-mast is provided with yards to facilitate the lowering of buoys, etc., in cable laying work. The accommodation for officers, electricians, engineers, etc., is well arranged, notwithstanding the ship's size is rather small compared with some other cable steamers.

On the bridge deck is the wheel house and chart room; also the captain's room, furnished in an up-to-date manner, and with private bath and toilet annexed. On the spar deck, under the bridge deck, are the state rooms for the officers, engineers and purser. The fore end of the bridge house is arranged as an electrician's testing room, and is completely equipped with benches and drawers, with the necessary electrical instruments. The staircase leading from the spar deck down to the saloon on main deck is covered by a steel house, and is commodiously arranged and handsomely paneled in oak.

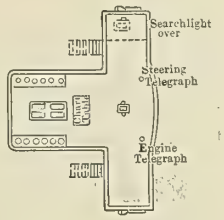
The saloon is situated at the after end of the vessel on the main deck, and with state rooms for the electrician's staff, on both sides. This accommodation is similar to that of the officers on the spar deck. The state rooms for officers, chief engineer, purser and chief electrician are provided with electric fans, and all the rooms are heated with steam. The space around the after cable tank is provided with rooms for the electrical hands. The 'tween deck space at the foremost end is for the crew and firemen. In all of these steam heating is provided.

In front of the foremost cable tank and on the main deck, the cable gear is located, as shown on the plan; this part of the deck is most carefully constructed for minimizing the vibrations caused by the motion of the cable engines.

THE JAPANESE CABLE STEAMER OGASAWARA MARU, THE FIRST CABLE STEAMER BUILT AND EQUIPPED IN JAPAN.



BRIDGE DECK.



PILOT BRIDGE DECK.

CABLE GEAR.

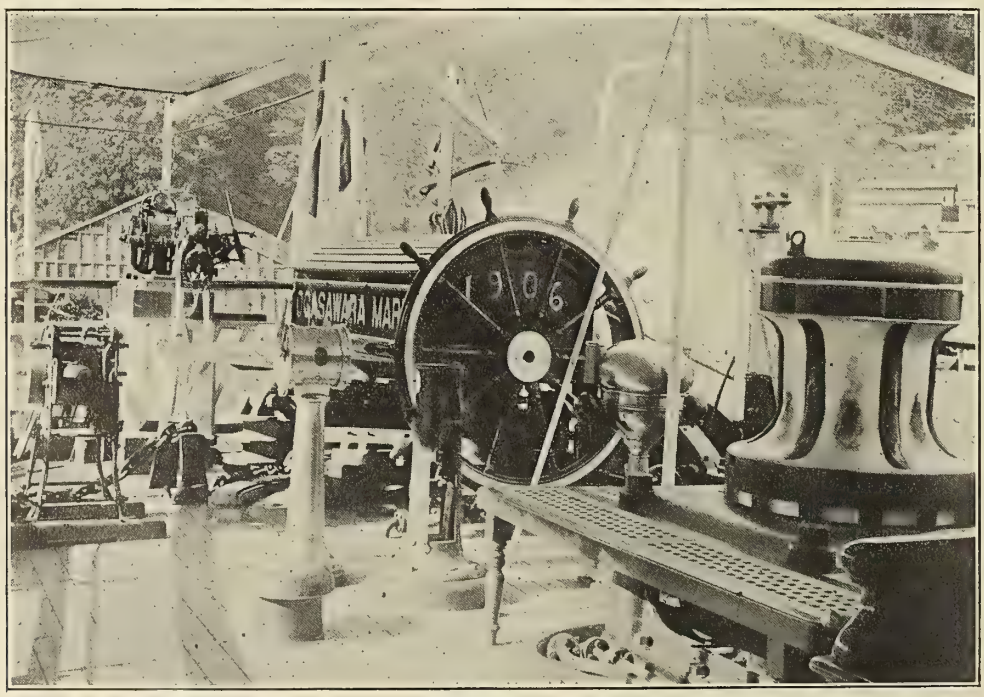
The double combined picking up and paying out machine, which is placed forward of the foremost tank, is very similar to that fitted in the cable steamer *Pacific*, and was supplied by Johnson, Phillip & Company. The machine is fixed on the main deck, with the winding drums appearing through an opening in the spar deck, all the handles for controlling the machine being

THE BOW OF THE VESSEL, SHOWING THE FORWARD SHEAVES AND GEAR.

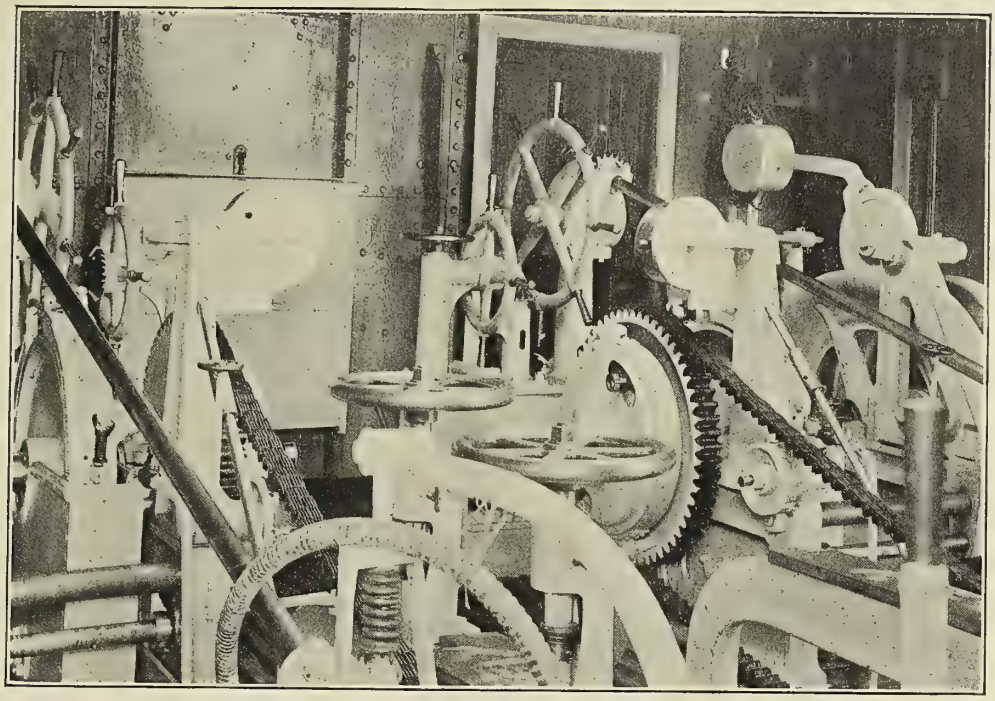
brought to the spar deck. This double machine practically comprises two complete and independent gears, both of which may be used either for picking up or paying out. This double gear is provided with two sets of steam engines placed fore and aft of the gear; either of the engines can drive the gear for picking up and also for paying out, when the pull on the cable is moderate. When a heavy load is on the cable, both engines are put into work conjointly.

The drums can be driven at three different speeds, by changing the gear wheels by means of clutches, which action can be performed from the starting platform on the spar deck. In the ordinary cable laying or picking up jobs, one of the engines may be kept as spare, since the power of one only is always quite ample for ordinary working. This reduces to a minimum the risk of total disablement of the gear.

The cable drums are 6 feet in diameter by 21 inches between the flanges, and they have steel gearing teeth and brake rings bolted to the rims of the drums for driving and holding, the drums being arranged to run loose on the shaft. The main brakes encircling the rings attached to the drum consist of steel bands, with elm block liners. They are made to close by means of right and left-handed screws actuated through worm gearing from handle wheels mounted on the stands on the starting platform. This arrangement gives very fine adjustment for the lighter load on the cable, and, at the same time, provides enormous holding power when necessary. To the back of each brake strap is fitted a water service pipe, so as to cool the rubbing surface of the elm blocks and drum. This cooling water is supplied from an independent small steam pump, which is arranged to be started or stopped from the starting platform. Both brakes can be coupled to each drum when an excessive load is on, and give a very powerful holding-back action to the machine.



STEERING WHEEL AND CABLE REGISTERING DEVICES ON THE AFTER DECK.



THE CABLE HANDLING GEAR AND BRAKES ON THE OGASAWARA MARU.

The hauling-off and holding back gears stand on the spar deck, and are driven from the geared drum by means of endless chain through a friction coupling and free wheel. These gears are made to traverse across the face of the drum by means of screws, in order to lead the cable to any position on the drum.

There are three sheaves in the bow gear. They have a U-section, run loose on a fixed shaft, cast iron whiskers or guards being provided between each two sheaves and at the outside to prevent the cable from getting out of the sheaves. The stern gear has only one cast iron sheave, mounted on a girder fixed on the spar deck, and is provided with whiskers.

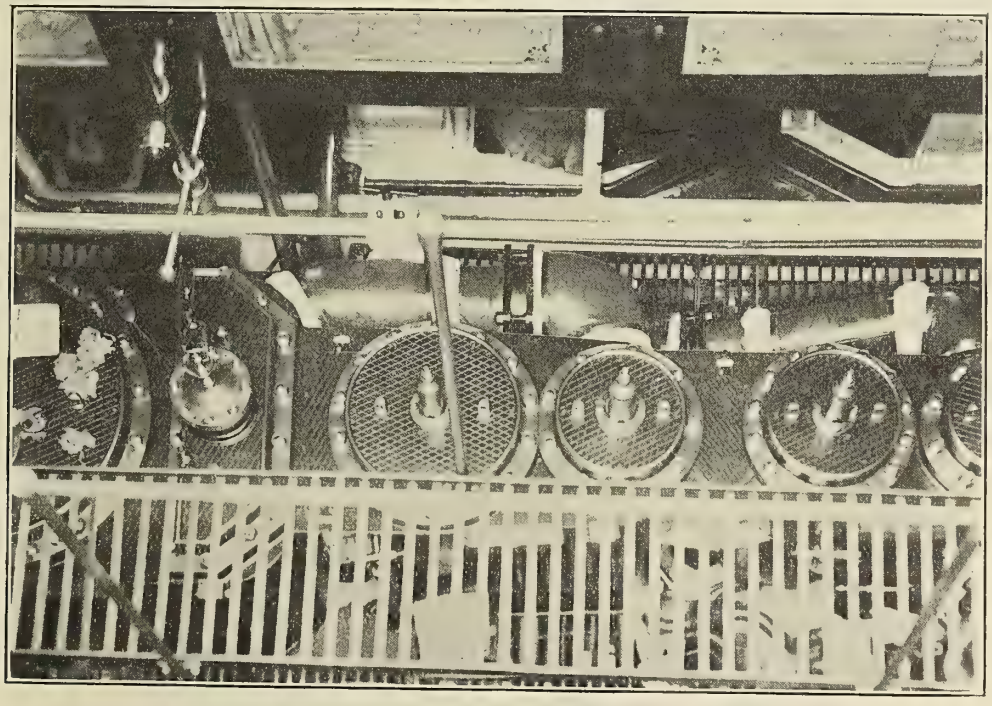
For registering the pull on the cable, three dynamometers are provided, these being fitted with Johnson, Phillip & Company's patent arrangement of internal spring. Their maximum readings are 25 tons for picking up purpose, and 5 tons for paying out. The usual cable leads to the dynamometers of V-shaped sheaves mounted on A-frames, are provided both forward and aft.

The cable engines were tried under steam outside Nagasaki harbor. The machine wound up the load of 25 tons, consisting of bundles of anchor cables, from the bottom of water 17 fathoms deep, and at the speed of one turn per 22 seconds, which is equivalent to 1.02 knots lifting speed of cable. In this case of heavy pull, the two sets of engines were used conjointly.

For the purpose of turning over the cable from one tank to another, or taking in cable from outside, two sets of electric hauling gears driven by a 6-brake horsepower motor of closed in type, were supplied by Johnson, Phillip & Company. They are driven off the electric main on the spar deck.

MAIN ENGINES AND BOILERS.

The propelling machinery consists of two sets of triple expansion engines, constructed under the Japanese government's



LOOKING DOWN UPON THE PORT ENGINE, SHOWING ARRANGEMENT OF CYLINDERS AND VALVES.

ship building regulations, with cylinders 14¾, 24 and 40 inches in diameter, by 27 inches stroke. The high and intermediate-pressure cylinders are fitted with piston valves; the low-pressure has the usual flat slide valve. The propellers are 11 feet in diameter and have each three blades of manganese bronze. The crank and tunnel shafts are of forged mild steel, and the tail shaft of extra strength of lock-fast iron, wholly incased with brass sleeves.

The air, main feed and bilge pumps are worked off the lever from the high-pressure crosshead, while all the other pumps are independently driven by separate engines. The condensers are also separate, and placed in the wings of the engine room, thereby giving more available space at the back of the engines. The circulating pumps, of centrifugal type, worked by small vertical engines, are placed underneath the condenser. Starting engines of "all round" type are provided; these same engines are also made to drive the turning gear through chain and messenger wheels, steam being supplied from the main and donkey boiler.

The steam generating plant consists of two single-ended Scotch boilers, and one donkey boiler of Cochran type. The main boilers are 14 feet in diameter and 11 feet 6 inches in length, with three

BOW VIEW OF THE SHIP, SHOWING FORWARD CABLE SHEAVES.

furnaces of 3 feet 6 inches internal diameter, for each. The flues are of Deighton's patent corrugated pattern, united to the combustion chamber with detachable ends. The working pressure of the main boilers is 185 pounds, and that of the donkey boiler 100 pounds per square inch.

AUXILIARY MACHINERY.

All the auxiliary machinery used in this vessel, which is absolutely necessary in the service of the ship, such as feeding of boilers, pumping out bilge water, electric lighting, etc., is in duplicate, to avoid as far as possible the risk of total disablement.

In the engine room, one auxiliary condenser, with air and circulating pumps attached, is fitted for receiving the waste steam from the several auxiliaries. One evaporator of 10 tons capacity, supplied by Caird and Rayner, of London, is fitted, with its accessories. It is so arranged that the steam produced may be admitted to the main and auxiliary condensers, and also to the intermediate-pressure receiver of the main engines.

Weir's feed water heater and Alley & McLellan's filter are fitted on the fore bulkhead of the engine room, and one Weir's feed pump is supplied at the fore end of the engine room, for the use of the auxiliary feed to the main and donkey boilers. The general service and ballast pumps are so connected as to be able at any time desired to send water to any of the cable tanks.

The electric installation consists of two sets of steam dynamo, supplied by Clark, Chapman & Company, Newcastle-on-Tyne, and operating at a voltage of 110. One dynamo is quite ample in power to light the whole installation of the vessel, except the search light. A search light projector of 16,000 candlepower is fitted on the flying bridge.

A refrigerating machine on the dry air carbonic system, supplied by J. and E. Hall, of London, is fitted in the port wing of the engine room, on the same seat as the steam dynamos. This machine is for cold storage and for manufacturing ice.

In the matter of deck machinery, the combined windlass and capstan is from Napier Brothers; winches and after capstan from Clark, Chapman & Company, and the steering engine from Caldwell & Company. A Kelvin sounding machine is provided; a James submarine sentry; and also a steam driven sounding machine for lifting samples from the ocean bed, as usual in cable steamers.

In boat equipment the steamer is provided with two sampans, two 22-foot steel life boats, and one steam cutter 30 feet long. The steam cutter is of the navy type, fitted with a watertube boiler and one set of compound engines, capable of developing sufficient power to propel the boat at 7 knots.

The Automatic Steam Towing Machine.

BY THOMAS S. KEMBLE.

MANILA HAWSER VS. WIRE LINE.

Prior to the introduction of automatic steam towing machines, the use of manila hawsers was necessary for ocean towing. These hawsers wore out rapidly by chafing in the chocks, and cutting in floating ice. They were too bulky to be wound on a drum, and had to be handled by a steam gypsy or messenger line, and coiled by hand. This was an extremely difficult and tedious process (especially when the line was frozen) and necessitated the slowing down of the steamer.

A flexible wire towing hawser can be stowed on the drum of a powerful steam winch, and hauled in without checking the speed of the main engines. It is not cut by ice, does not rot when water-soaked, is lighter and cheaper than manila hawser of equal strength, and far more durable. Repeated trials have demonstrated, however, that being inelastic, it is broken by shocks which a much weaker manila line could ease by its stretch, and so withstand.

HISTORY OF TOWING MACHINES.

As early as 1878, Scott and Gilmour (English wire rope manufacturers) applied for a patent on a steam or air "cushion cylinder" with "buffer springs" inside the heads, to lend the needed elasticity to wire tow line. They also suggested that the line be fastened to the drum of a steam winding engine, and the winding strain of the engine be made to sustain the load, giving a cushioning effect analogous to the steam or air cylinder. The Taylor patent (British, 1880) described a steam winch with a towing drum driven by a friction clutch, so as to allow the drum to be overhauled (slipping the friction) before the line parted; and suggested a connection to a valve which was to be opened by the line paying out to give steam to the engine and wind it in again. In 1885 the McHardy (British) patent described a buffer towing cylinder filled with compressed air. The valve on the air-compressor was to be automatically operated to increase the pressure in the buffer cylinder as the strain increased.

It does not appear that any towing machines were actually built according to any of these suggestions. It remained for American inventors to combine these ideas into a practicable operative machine. In 1888, T. J. Shaw, chief engineer of the Harlan and Hollingsworth Shipbuilding Co., and shore engineer Spiegle, of the Boston Tow Boat Company, designed and built the first automatic steam towing machine of which we have record, and

installed it on the *Orion,* a large and powerful steamer towing heavy consorts from the Cape Breton coal fields to Boston.

In this interesting pioneer machine we find the steam cushioning winding engine of Scott and Gilmour; the automatic connection to the steam valve, of Taylor; and the pressure controlling valve of McHardy. The *Orion* machine was fitted with 16 by 16-inch cylinders, cranks set quartering, and a link reverse. The drum was 40 inches in diameter, and was scored for 1⅝-inch wire hawser. A pressure regulating valve bolted to a side frame was operated through friction cones and a screw, by gearing from the drum shaft. The rotation of the latter altered the adjustment of the valve to balance the varying pull of the tow line, and the frictions slipped at either limit of adjustment.

After a short trial, the engineers on the *Orion,* with the consent of the inventors, substituted a slide throttle valve for the pressure regulating valve, which had operated too slowly, and could not be kept tight. This throttle valve had triangular ports, giving a small opening at the vertex, uncovering slowly at first, and then rapidly toward the end of its travel, as the base of the triangle was approached.

The practicability of the towing machine was demonstrated by the success of the *Orion,* and it came rapidly into favor, both on the Atlantic and the Great Lakes. The American Ship Windlass Company, of Providence, R. I., acquired the rights of manufacture from the patentees, and advertised it with great vigor and persistence. This company also substituted a windlass reverse valve for the reversing link, and improved the automatic mechanism by an invention of its superintendent, Frederick Metcalf. This substituted a positive mechanism for the friction device, which had given much trouble in practice, and it has been used on all their machines ever since.

In 1896, the Chase Machine Company, Cleveland, Ohio, entered the field. Their automatic mechanism was connected direct to the reverse valve, in such a manner that it could be disconnected, and the machine operated by hand. This did away with the special automatic valve, and the by-pass which had been used when the automatic was thrown out. The reverse valve had wide short ports, and opened more rapidly than on previous machines. Still later machines designed under the direction of Mr. Metcalf, now treasurer of the Chase Company, have shown successive improvements, until the latest type, which comes as the result of years of experience in building and of watching their operation in actual service, differs radically from the earlier machines.

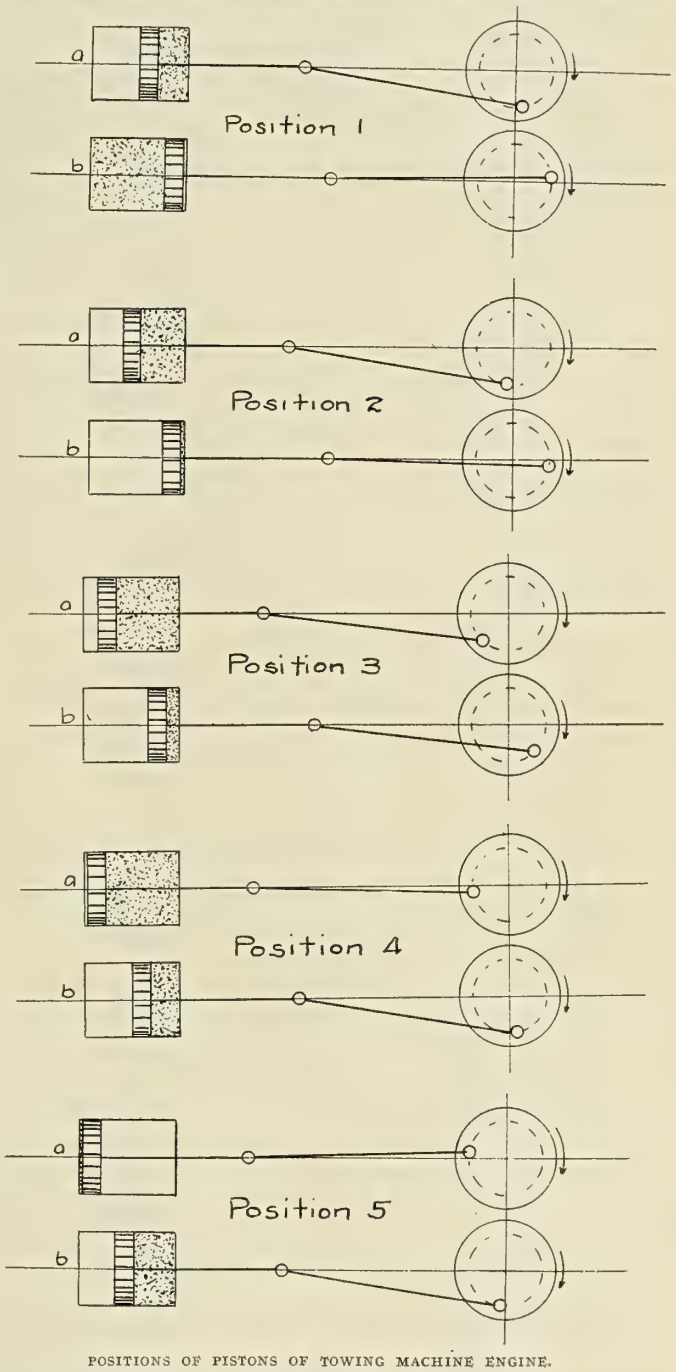
Before describing this type it will be advisable to take up a somewhat detailed discussion of the theory and practical operation of towing machines in general.

THEORY AND PRACTICAL OPERATION.

The drag of the tow line is carried (assisted by the friction of the machine) on the steam pressure in the cylinders of a spur geared, double-cylinder engine, with an admission valve automatically operated by the paying out and hauling in of the line, and with cranks set quartering. The power of the engine is chosen to equal the safe working strength of the tow line to be used, and all parts are designed to be stronger than the engine power, so that the engine will be overhauled before anything strains beyond the limit of safety. The torque available to resist paying out of the line is equal to the friction of the machine, plus the product of the pressure against the pistons into their leverage.

Such an engine varies considerably in the leverage which the pistons have over the load, and in the steam pressure against the pistons. The starting or resisting torque of the engine is a minimum when one crank is near dead center, and a maximum when both cranks are not far from quarter stroke.

Under ordinary conditions, such an engine will stand holding the pull of the line on the steam pressure (aided by the friction of the machine) with the cranks near the position of minimum torque, absorbing ordinary shocks by cushioning on the steam, the cranks moving with increasing resistance toward, but not beyond the position of maximum torque, and then moving back toward the first position as the load decreases. In this operation only a few inches of line are paid out and recovered, and as the ports do not open to exhaust, there is no consumption of steam. If, now, there comes an extraordinary pull, which exceeds the resisting power of the engine with the cranks at the position of maximum torque and with existing steam pressure, the engine will be overhauled past this position, and the line will continue to be paid out until the pressure is increased sufficiently by the wider opening



POSITIONS OF PISTONS OF TOWING MACHINE ENGINE.

of the automatic valve, or the load falls off to equal the maximum resisting torque. The engine then stands until the load falls below the engine power, and then winds in until the load increases again or the steam is throttled by the automatic valve, causing a balance to be set up anew between the load and the resisting torque. It is primarily upon the automatic valve and the manner of its operation that the degree of success of the towing machine depends.

In the Shaw and Spiegle machines as built unchanged from 1888 to date, the operation of the automatic valve may be described as follows: As soon as the engine begins to wind in the

line, the valve begins to cover the triangular port and, as it covers the base of the triangle first, the closing is comparatively rapid at first, and throttles the engine before it can run away, even under light load. As the line continues to wind in, the valve moves the same distance (about 1/32-inch) each stroke, closing the port opening more and more slowly, throttling the steam, and slowing down the engine until it fails to go over one of its dead centers, and stops. This stoppage occurs when the valve has shut down to such an extent that only enough steam gets through to make up for leakage and condensation, and so maintain pressure to balance the load with the cranks at some position between 3 and 4. As stated above, in ordinary weather the cranks rock back and forth between position 3 and position 4, as the load varies. When there comes a pull greater than the resistance offered by the engine with the cranks at position 3, the engine will be overhauled beyond this position, thus decreasing the leverage. The pressure will be increased, due to the compression of the steam in the cylinders and in the steam passages. The port opening is increased so little in the first few strokes as to have practically no effect.

In passing from position 3 to position 2, the pressure may or may not increase sufficiently to make up for the decrease in leverage. As the cranks pass from position 2 to position 1, the steam, which has been compressed to the volume of one-half of one cylinder plus that of the passages, is suddenly allowed to expand to the volume of one and a half cylinders plus that of the passages, reducing the pressure to what it was at position 4. But as the engine has gained some momentum, the resistance is even less than that when holding the load at position 4. The drum, moreover, makes several turns before the valve opens wide enough to check paying out, and the port is not clear open until about a dozen turns have been made by the drum. Considerable line is therefore paid out needlessly, and steam is consumed in recovering it. The valve ceases to move as soon as the port is wide open, but begins to close down as soon as the engine begins to wind in, and so prevents running away. The closing is accomplished in the same number of turns, however, as was required for opening, so that the engine comes to rest with the line lengthened by just so much as was paid out after the valve was wide open. If this is repeated a number of times, the line may pay out to the end, and break either the line or the machine.

In the latest type of the Chase machine, the automatic mechanism is actuated by pin and intermittent gearing, and is so designed that as the engine begins to wind in, the valve immediately closes down to a point where there is sufficient opening to operate the engine under load at the proper speed, but not enough to run it away and do damage, even with no load. The valve is left in this position until the line has been hauled in to the required length, at which time the valve closes completely in a quarter stroke of the engine. The port is completely covered just as the cranks arrive at a point midway between positions 3 and 4. As the engine continues to haul in during the next eighth stroke, the pressure decreases, due to expansion, and the leverage continues to fall off. In practice the engine stops with the cranks at about position 4. If, now, there comes a shock on the line, the cranks are hauled back toward position 3 with increasing leverage and steam pressure. If they are hauled past the position where the valve closed, it will begin to open, admitting more steam. Ordinarily the engine will absorb the shock without passing position 3, and when it eases off, the cranks move back toward position 4. Also, if the engine stands for a time under a steady strain with the valve closed, the condensation and any leakage which may exist will cause the pressure to fall off, and the cranks will move toward position 3, with increasing leverage maintaining the balance between pull and resistance, until the valve begins to open and raises the pressure, causing the cranks to move back again to position 4.

If there comes a pull greater than the engine can resist at the position of maximum torque, the engine will be over-hauled past position 3. The valve will then continue to open, and by the time the piston has passed from position 2 to position 1 there will be sufficient passageway for the steam to rush into the other end of the cylinder, and oppose its return stroke with full power. By the time that the piston *a* reaches the end of this stroke, the engine may be going faster, but the port will by this time be wide open, so that there is still plenty of passageway for the steam to get in and oppose paying out with full pressure. It may be explained here that the ordinary port opening would not be sufficient for this operation, and that the ports and all steam passages on these engines are made four times as large as is necessary for forward running, in order to allow the steam to get in and fill the whole cylinder instantly to full steam pressure at the beginning of every stroke. This is a particularly desirable feature in narrow, crowded, or shoal waters, where the barge sometimes takes vicious sheers, and the full power of the engine is needed instantly to avoid collision or grounding.

Another feature of these machines consists in the fact that after the valve is wide open it is locked there, and from 12 to 80 fathoms (according to the size of the machine) can be paid out against the full power of the engine and recovered automatically, bringing the line back to exactly the original length. This amount, 12 to 80 fathoms, is considered sufficient for all contingencies, and could be increased if requirements demanded.

There are probably about two hundred automatic steam towing machines now in use, in all parts of the world. The most widely heralded feat ever attempted with steam towing machines was the towing of the United States government dry-dock *Dewey* from the Chesapeake to Manila. Three of the largest size Shaw and Spiegle machines were used, with three steamers towing tandem. In spite of the great amount of rough weather encountered, and some accidents, the task was accomplished, and the dry-dock brought in safety to its destination.

Another notable achievement is that of the steamer *Francis H. Leggett,* fitted with a Chase machine, which for the last four years has been towing enormous log rafts from Stella, Washington, across the Columbia river bar, and down the Pacific coast to San Francisco. These rafts comprise about 11,000,000 feet of lumber, measure 740 feet in length by 60 feet in width, and draw 24 feet 6 inches of water. The towing machine on the *Leggett* has cylinders 15 inches in diameter and 18 inches stroke, and the drum stows 1,800 feet of 2⅛-inch wire hawser. The Chase Company is building still larger machines, equipped with 18 by 20-inch cylinders, and designed to carry 3,000 feet of 2¼-inch wire line, for the service of the Standard Oil Company, in towing across the ocean.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of June 10, 1907, the following precentage of completion of vessels building for the United States Navy:

	Tons	Knots		May 1	Jun. 1
BATTLESHIPS.					
Mississippi	13,000	17	Wm. Cramp & Sons.....	84.69	87 47
Idaho	13,000	17	Wm. Cramp & Sons.....	78.11	79.9
New Hampshire	16 000	18	New York Shipbuilding Co.	67.9	72.5
South Carolina.	16.000	18½	Wm. Cramp & Sons.....	11.21	14.57
Michigan	16 000	18½	New York Shipbuilding Co.	13.1	16.4
ARMORED CRUISERS.					
South Dakota..	13,680	22	Union Iron Works.....	07.4	97.4
North Carolina.	14 500	22	Newport News Co.....	78.8	80.69
Montana	14,500	22	Newport News Co.....	72.9	74.89
SCOUT CRUISERS.					
Chester	3 750	24	Bath Iron Works.....	75.58	78.6
Birmingham ...	3.750	24	Fore River Shipbuilding Co	70.3	75.3
Salem	3 750	24	Fore River Shipbuilding Co	72.1	77.0
SUBMARINE TORPEDO BOATS.					
Cuttlefish.....	—	—	Fore River Shipbuilding Co.	92 5	95.
Viper.....	—	—	Fore River Shipbuilding Co.	91.6	92.6
Tarantula.....	—	—	Fore River Shipbuilding Co.	93.5	95.
Octopus.....	—	—	Fore River Shipbuilding Co	91.4	93.

The New Hamburg-American Liner President Lincoln.

This new steamer, which is a sister of the *President Grant* (soon to appear), reached New York on her maiden trip, after a stormy voyage, early on the morning of June 13, and sailed for Hamburg June 22. The ship covered the distance of 3,047 nautical miles from Cuxhaven to Sandy Hook in 9 days 18 hours and 54 minutes, the average speed being 12.97 knots. The days' runs were 360 nautical miles as a maximum and 241 as a minimum, due to bad weather. The maximum represents a speed of 15 knots and the minimum of 10.04 knots.

These steamers were built by Harland & Wolff, Limited, Belfast, and were intended originally for the Leyland Line. Before completion, however, both vessels were taken over by the Hamburg-American Line. They measure 615 feet in length, with a beam of 68 feet 6 inches, a gross tonnage of 17,540 tons, and a net tonnage of 11,233 tons. The hull is constructed of steel, with a cellular double bottom extending the full length, and watertight bulkheads form a subdivision intended to provide fully for safety. The steamer presents a unique appearance, largely because of her six pole masts fitted with cargo derricks, this being the first six masted steamer, since the famous *Great Eastern*, to enter the port of New York. The derricks are all of five tons' capacity, and six are located on each mast, with the exception of the fourth and sixth masts, counting from the bow, which have respectively four and three derricks.

THE HAMBURG-AMERICAN STEAMSHIP PRESIDENT LINCOLN; THE FIRST SIX-MASTER SINCE THE GREAT EASTERN.

On the promenade, bridge, awning and upper decks are provided accommodation for 324 first class passengers, a number of the state rooms being fitted with a single berth each. The first class dining saloon is situated on the upper deck amidships, and covers the full breadth of the vessel. Accommodation is provided for 228 diners. This compartment is finished in polished hardwood, with satinwood and lincrusta panels and a parquet floor. A large smoking room is placed aft on the boat deck, the paneling and framing being of carved oak, and the seats and chairs upholstered in maroon leather. The floor is covered with india rubber tiles, while a skylight with a butterfly design is placed over the center of the apartment. The social hall is located at the forward end of the boat deck, and is paneled in carved satinwood, inlaid and upholstered in moquette. An electrically operated gymnasium and a room for electric baths and massage have been placed on the boat and bridge decks, while a small room devoted to the wireless telegraph equipment enables messages to be sent to a radius of 150 miles, and received from a somewhat greater distance, from more powerful installations.

The second class accommodation provides for 125 passengers in two, three and four berth rooms, located aft of the first class quarters. The dining saloon will seat all of these passengers at once, and is furnished and decorated in white, with medallions in panels; the smoking room and social hall are also tastefully decorated. Third class passengers are accommodated on the middle and lower decks aft, where provision is made for 1,004. The dining saloon on the upper deck aft will seat 400, and is paneled and decorated in white. A smoking room is provided for third class passengers. Steerage accommodations are placed on the middle and lower 'tween decks, for 2,320 persons. This makes a total passenger capacity of 3,773. The crew numbers 344, making a total personnel of 4,117 when all berths are filled.

To deal expeditiously with the large cargo which this vessel will carry, there are eleven cargo hatches for the seven holds, and steam winches operate in conjunction with the steel derrick booms, before mentioned, to load and unload the cargo. On the orlop deck are large store rooms for provisions for the passengers, including refrigerating rooms for meats, etc. The system of ventilation consists of both natural and artificial types, the latter being by means of electric fans. Electric hoists are installed to convey goods from the store rooms to the galleys and pantries, and a number of electrically operated machines are in use in the culinary department for various purposes. There are sixteen large lifeboats, besides a provision of life rafts carried in four stacks. The ship is fitted with bilge keels, to minimize rolling.

The propelling machinery consists of two sets of quadruple expansion engines driving twin screws, with a maximum of 8,500 horsepower and a sea speed of 14 knots. The cylinder diameters are respectively 25, 36, 52 and 75 inches, with a common stroke of 54 inches. At full power the revolutions per minute are 86, corresponding with a piston speed of 774 feet per minute. The low-pressure cylinders are fitted with D-slide valves and a balance cylinder, the other cylinders having piston valves, one for each cylinder. The arrangement of cylinders places the high-pressure forward, with the second intermediate next, then the low-pressure, and the first intermediate aft. The high-pressure and low-pressure valves are forward of their respective cylinders, the other valves being aft. These valves are operated by Stephenson double bar links, actuated by two eccentrics each. The engines are balanced on the Yarrow-Schlick-Tweedy system.

Steam is furnished by six boilers, of which four are double

ended and two single ended. There are three furnaces in each end of the double-ended boilers and three in each of the single-ended, making a total of thirty furnaces. The aggregate grate surface is 55 square meters (592 square feet); the heating surface is 2,100 square meters (22,600 square feet); the ratio between the two is 38.2 to 1. The boilers are all of a diameter of 14 feet 8 inches, the lengths being 19 feet 10 inches and 10 feet 9 inches respectively. Howden's forced draft installation is fitted. The steam pressure is 215 pounds per square inch.

The condensers are located in the back columns of the low and first intermediate cylinders, that is, in the after half of the engines. The propellers have each a diameter of 6 meters (19 feet 8 inches) and a pitch of 6.1 meters (20 feet); this makes a pitch ratio of 1.017. The shafting is carried out through spectacle frames to avoid the use of outside struts. There are eleven sections in each shaft, the two sections of crank shaft having a diameter of 15½ inches. The thrust shaft has seven thrust collars. The line shaft, in seven sections, is provided with two bearings to each section for steadying purposes.

Four sets of direct connected generators and engines furnish electricity for both lighting and power purposes. Three of these are of 480 amperes capacity each, and the other of 200 amperes; all are operated at 100 volts, the larger types being run at 300 revolutions per minute. The three larger ones have compound engines with cylinders 10 and 17 by 10 inches, and are located just aft of the engines, on the main engine room floor. The fourth unit has a single cylinder, 9 by 8 inches, and is located in a little compartment above the waterline, just aft of the engine room, in order to be available in case of emergency, should the engine room be flooded. All were furnished by W. H. Allen, Sons & Company, Bedford. The refrigerating machinery, which includes a compound steam engine operating a single compressor, was furnished by J. & E. Hall of Dartford. The anchor winch is from John H. Wilson & Company, Ltd., Sandhills, Liverpool.

Tubing a Tramp in the Tropics.

Several years ago I took a berth as second engineer in a ship bound from Cardiff to Capetown with coal, and thence to parts unknown. She was a packet of about 3,000 tons, of the usual tramp class, and steamed about 8 knots when we could get it. The trip to the Cape passed without any unusual incident. We discharged our coal there, and began to load up for Mauritius. While we were lying at Capetown the chief was offered a post at the Kimberley diamond mines at about twice the amount of salary he was receiving in his present position. He was deterred from at once accepting it only by the idea that if he did so the owners might report him to the government for deserting his ship in a foreign port, and his certificate might be suspended, in which case he would be unable to take another berth as chief in a British ship, if the job at Kimberley proved to be unsuitable. Finally, however, the rumors of the money to be made at Kimberley overcame his discretion and he left the ship.

Next morning our captain came to me and asked me if I had not seen sufficient service at sea to sit for my examination as chief, and when I told him that I had, and that I intended to sit for it when I returned to England, he asked me if I would sit for it in Capetown, if he could get me the special license provided for in such cases by the Merchant Shipping acts. I agreed to do this, and was examined next day by the superintendent of the Castle Line and one of the chief engineers. The examination took place in one of the mail boat's engine rooms, and consisted of answering practical questions regarding the management of boilers, operation of main and auxiliary engines, repairs in case of breakdowns, and reading indicator cards. This examination lasted about two hours, at the end of which time I was declared competent to take the ship, as chief engineer, to the East and back to England. The third engineer was in about the same position as I was with regard to his second engineer's certificate, and he was also examined and declared competent to act as second engineer. The captain congratulated us on our success, and enlarged upon the opportunity which we young men now had to show the stuff we were made of, and to our astonishment said that though we were promoted he would, of course, expect us to sail for our present wages, but as the owners were gentlemen he was sure they would suitably recompense us for our valuable services upon our return to England.

The third engineer and I both refused to accept promotion under these conditions, and the "old man" threatened us with all sorts of terrible but somewhat vague punishment for our recalcitrant behavior. We consulted the leading engineers in port as to our conduct, and were assured of their support. Next day the captain told me to light the fires in the boilers. I immediately complied, and the smoke was soon curling lazily from the funnel. Next morning the captain asked me if we were all ready to leave, and was much surprised when I told him there was no steam on the boilers, as he had not told me what time he would require it; and, furthermore, that I would not move the engines until there was a chief engineer on board. He then offered us the money of the port if we would accept promotion, but we now "had our monkey up," and refused to accept promotion under any circumstances. He wired the broker, who came down to arbitrate, and finally I agreed to take the ship out to her anchorage in Table Bay, if he would promise to go ashore then and find a chief. This he agreed to do, and we carried out this arrangement. He brought a chief on board with him, having had to agree to pay him 50 percent more than he offered me.

The "old man" had shipped fifty horses at Simons Bay on his own account, and we sailed away next day for Mauritius, where he immediately disposed of them at a good profit; but he "forgot" to give us the bonus he had promised us if we kept a good supply of condensed water for them. After selling the horses we next sailed to Diego Garcia, a beautiful island in the Chagos Archipelago, covered with cocoanut palms, where we anchored. The captain went ashore (for what purpose I do not know) and then we set our course for Diamond Island, in the same group, where we received orders to proceed to Rangoon, Burmah. We arrived there in due course, and began to load teakwood logs.

Several plates had to be cut out of the bulkheads to permit of some of the largest of these being shipped, and the captain went to one of the firms ashore to get an estimate for this job, and then he came aboard and asked us (the third and I) how much we would do it for. As our offer was lower than that of the shore firm, he accepted it, and I got a written agreement from him this time, arranging to pay us immediately the job was done. This was carried out, but the old man had forgotten to arrange for the replacing of the plates in his agreement, and was disgusted when I drew his attention to his lack of foresight. However, to show that "there was no ill feeling," we put them back again, as the ship would not have been permitted to go to sea with her bulkhead plating off.

We lay six weeks in Rangoon, and while there a Serang and his boys came aboard and scaled the boilers. Now, our tubes were in a pretty rotten condition, especially in the port boiler, and I suggested to the chief that while it would be a good thing to have the furnaces and combustion chambers thoroughly scaled, it would be advisable to let the tubes alone, as the scale was all that was keeping them tight. He resented my suggestion, and had the tubes scaled also. I regarded this operation with somewhat mixed feelings, but consoled myself with the reflection that we had a full set of spare tubes on board, which had been put there, in case of trouble in a foreign port, as the next best thing to renewing them, which the owners had intended to do the previous trip in the home port. A good charter turning up, however, they had decided to risk the boilers for another trip.

We left Rangoon for Aden to coal, and were not a day at sea when the port boiler tubes began to leak. We had about twenty tube stoppers on board, and these were soon used up. Then we kept the carpenter busy making wooden plugs with a ½-inch hole through them. These we drove into the tubes, and the water, leaking through the hole and evaporating, soon salted them up. By the end of the fifth day the port boiler was useless, and our speed was reduced to about 3 knots. The chief now collapsed under the strain, and was *non compos mentis* until we got into the Mediterranean a couple of months later, and here we will let him disappear from this yarn. I was now again in responsible charge, and the captain asked me what I intended to do. As the most sensible plan, I suggested putting back to Rangoon. He would not listen to this, but said he would go south again to Diego Garcia, where we could lie quietly and fix the boiler. So we meandered gently along at 3 knots until one evening we anchored alongside the beautiful cocoanut palms again, and drew the fires out of the port boiler.

Next morning we began to cut the plain tubes out of this boiler, and on trying the new ones we found to our disgust that they were about 3/16 inch too small for the holes. As I was somewhat dubious about the quality of the new tubes, I thought this amount too much to expand them cold; so I made a mandrel out of greenheart and put an iron band around it, and after heating the tubes we hammered them on this with a teakwood mallet made by the carpenter, until we had expanded them sufficiently to make a nice driving fit in the plate. For sixteen weary days and nights we toiled, expanding, fitting and cutting out, until the boiler was retubed throughout, and when the last of the 240 tubes was in we were more like skeletons than men, as Diego Garcia, though beautiful to look at, is a "hell' to work in. We had no regular hours, just worked until we were played out, took a nap, and began again. When we were finished we tested the boiler to twice the working pressure with water, and every tube was tight but one. We were highly elated at our success, and took the bad tube out and put a tight one in, so as to know that we had made a thorough job, even though we could only form a mutual admiration society in the fireroom. The "old man" kept the ship lying there two days longer to give us a little chance to recuperate, and on these two days hangs a tale.

We then sailed for Aden, and when about eight days from there we got into the monsoons, in which we dodged along nicely until some one left one of the bunker hatches open on deck, and we shipped a sea down the bunkers which flowed into the fireroom; filled the bilges and drowned out the low fires. In the midst of this little excitement the joint between the shell and the main feed check on the port boiler blew out, and we had to draw the fires in the boiler, as we were unable to keep water enough in it. The steam immediately fell, the engines slowed down, and the ship got into the trough of the sea and rolled heavily. To make matters worse, every stud proved to be corroded away, and we had to bore them out and renew them. This job took about six hours, and then we started the boiler again, and eventually got into Aden the day after the owners had put 60 guineas premium on us, as we were 35 days overdue from Rangoon.

We coaled up at Aden and Port Said, and sailed along the Mediterranean without any incident worth mentioning, until close to Gibraltar, where we ran into a fog bank and heard a crash in our vicinity. Cautiously moving through the fog, we found two steamers interlocked, and the grain pouring out of the side of one of them. Our "old man" saw a chance to recover some of the loss on our trip, and took one of them in tow, but two torpedo boats came out from Gibraltar, accompanied by two tugs, and the officer in charge ordered our captain to cast them adrift, which he did.

The remainer of the trip through the Bay of Biscay and channel was uneventful, and we got into London, to be received somewhat coldly by the owners for obvious reasons, but were amply repaid for our trials by the welcome of our friends, who received us as men returned from the dead. I got an excellent reference from the superintendent for my "valuable services," and was offered the first vacancy in their fleet, but was unfit to accept a berth for some months, as I still felt the effects of the sixteen days at Diego Garcia.

Several years later I was leaving one of the Clyde ferries at Glasgow, when I was hailed by a disreputable looking individual, who proved to be my late chief, who had deserted us to go to Kimberley. From his somber story I gathered that while at the mines he had made some money and collected a nice variety of bad habits, and that the latter had soon assisted him to dispose of his surplus cash, and unfitted him for regular employment; with the result that he had drifted from bad to worse, until now he was merely a casual laborer at the docks. J. M.

NOTES ON NAVAL SCIENCE TOPICS.

BY ARTHUR R. LIDDELL.

Naval science, like every other, affords opportunities at intervals for fresh stock-taking. New facts and theories crop up, and old ones are unearthed and brought to honor. It frequently happens, also, that the thoughts and inventions of earlier workers, which in their day were left unheeded because they did not at once find their place in the general fabric, reappear under new names, and fulfil their destiny. Some of the problems in the designing and working of ships, which just now seem to merit attention, will be commented upon in the following:

PROPORTIONS OF VESSELS.

The proportions to be borne between the principal dimensions, length, breadth, and depth, of a steam vessel are generally determined with reference to speed, strength, and prevailing fashion, and to a certain extent to stability. There are other considerations, however, to which attention ought to be paid in designing. If the midship section of a vessel be squared below water, that is, be made to take a square form of equal area, and a line parallel with the water line be drawn in the longitudinal plan at the height of the new bottom thus formed, an equivalent block will be produced, which may be used for approximately determining the metacentric conditions (see Figs. 1 and 2). Any erection there may be on deck must then be shortened at each end in proportion as it is lighter than the rest of the structure and its contents. The center of gravity of the vessel loaded with a homogeneous cargo may be taken nearly at the center of mean distances of the longitudinal plan of the block. For full-lined vessels the height of the metacenter above the flattened bottom is nearly equal to the breadth multiplied by a coefficient which may be taken from the following table:

Propor. of Draft to Breadth.	0.2	0.3	0.4	0.5	0.6	0.7
Coefficient	0.517	0.403	0.408	0.417	0.439	0.469

The heights of the metacenters of finer vessels will be lower than those given, by percentages which, for given coefficients and given styles of model, will not greatly vary. After a little experience, designers will know how much to deduct from the tabular figures for their own models.

The general conditions in regard to stability are thus given. The center of gravity of the vessel being at the center of mean distances of the longitudinal plan as above corrected—practically at about half height—the depth of the vessel can be so chosen that a given metacentric height *(G M)* is obtained.

Suitable proportions of depth to breadth having thus been attained, it now becomes necessary to choose the length. This is fixed by the following considerations: The longer the vessel, the greater must be the height of her free side, so that, the breadth and depth being given, the greater the length, the shallower will the draft become. Naturally, also, the greater the length, the greater will be the strain on the longitudinal structural parts. On the other hand, a certain length of vessel may be necessary for speed, and restrictions in regard to draft may

make it advisable to distribute the displacement, and the bulk of the vessel generally, more in the longitudinal direction than would from other considerations seem desirable.

Another question, which here presents itself, is that of the "under load-line." The light draft of a vessel must bear a certain proportion to her length, very much as does the freeboard above the deep load-line. The draft should be not less than half the assumed maximum height of a wave that has the same length as the vessel. A further draft allowance should be made in vessels with considerable rise of floor, and in those in which the axis of the propeller lies relatively high.

It appears, then, that if the length of a vessel be gradually increased, and the area of the midship section at the same time gradually reduced, so that the cubic capacity and the proportion of breadth to depth remain the same, the thickness of the slice between the deep load-line and the under load-line will become gradually less, until a limiting point is reached, at which the two lines coincide. The slice in question represents weight of cargo which can be carried, and although the limiting point at which cargo carrying capacity becomes nil may never be approached in practice, the disadvantages of unduly extending the length of a vessel are clearly considerable, even apart from the question of increase of weight of structure by which the extension is accompanied.

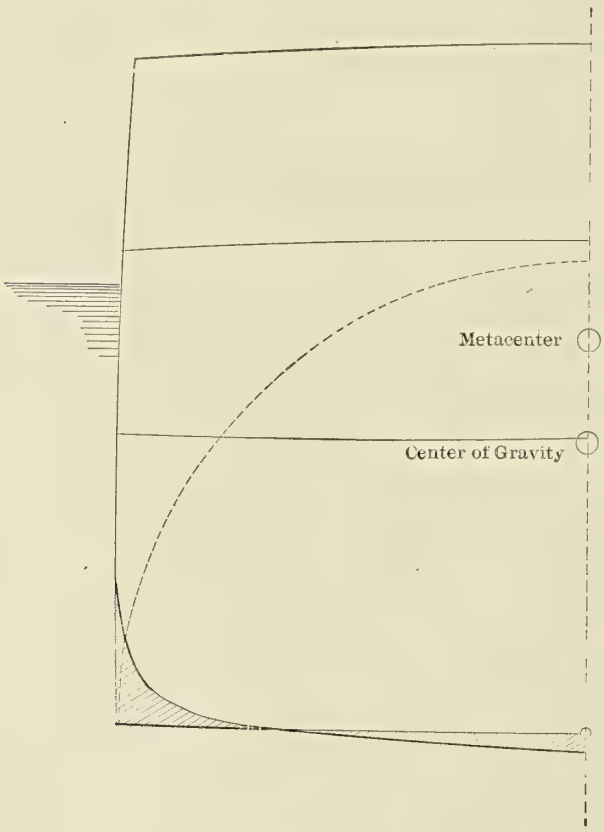


FIGURE 1.

In the case of sailing vessels ability to stand up under a press of canvas becomes an all-important factor in the calculation, and the length of the vessel has also to a greater extent to be determined by considerations in regard to maneuvering. Sail-carrying power depends upon the proportion of depth to breadth. The heights of the center of gravity and of the metacenter may be approximately determined in the manner above referred to. For ordinary ship-shape vessels, the vertical distance between these points should lie between 2 feet 6 inches and 4 feet, the best proportions for all sizes of vessels being those in which it is from 3 feet to 3 feet 6 inches.

The reason why the best metacentric height for all sizes of vessel is nearly a constant is that, while stability varies with the fourth power of the dimensions, the moment of sail which a vessel can carry varies approximately with the cube only. The moment to resist farther heeling at a given angle is proportional to length × breadth × depth × lever, or to dimension^3 × lever: that of the sails to length × height of sail × leverage of sail, or to dimension^3. If then the two opposing moments are to remain equal for all sizes of vessel, the lever factor of the stability, which is in direct proportion to the height of the metacenter above the center of gravity, must be kept constant. The length factor, being common to the two moments, may be disregarded, and the height and leverage of the sail spread being governed chiefly by the breadth, there remains only the proportion of depth to breadth to be considered. As a convenient rule for approximately fixing this, the following may be suggested:

Find the depth to breadth at which the height of the metacenter above the center of gravity is nil, and then deduct from the former twice the metacentric height (known as the *G M* height) desired. A correction will have to be made on account of the reduced proportion of draft to breadth affecting the height of the metacenter above the base, but this may easily be determined from the table above given. The conditions under which depth to breadth is such that the *G M* height = 0, will vary with different heights of rig, different extent of erections, etc.

A certain vessel 270 by 43 feet by 25 feet 8 inches molded dimensions has a *G M* height of 1 foot 9 inches when loaded to her deepest draft with a homogeneous cargo, and one of 3 feet 6 inches as usually stowed, with heavy cargo below and lighter cargo above. With a molded depth of 25 feet 8 inches + 3 feet 6 inches × 2 + 1 foot 4 inches, her *G M* height in the last-mentioned condition of loading would be = 0, the quantity 1 foot 4 inches being the correction for metacentric height above base, referred to in the foregoing.

Such rules must, of course, be used with a certain amount of discretion, but this is the case with most problems with which the naval architect has to deal, and they at least afford a rough means of jumping at conclusions, which in all cases have to be verified by calculation.

Another condition which often has to be fulfilled in a sailing vessel is that of standing without ballast. This is largely a question of keeping down the rise of floor, so that the light waterline cuts the side above the bilge, and thus has a relatively large moment of inertia, but the above-described method may also be applied in passing from size to size of similarly shaped and conditioned vessels.

FREEBOARD.

The English freeboard regulations have lately been revised, but the freeboard question in general is far from being at rest. Complaints were rife until recently, that foreigners brought their vessels into English ports more deeply laden than English captains were allowed to do, and international agreements which were intended to remove these grievances brought peace only for a time. Such instruments are made to be evaded, and there is the more excuse for this here, that the regulations rest upon bases that are in many cases very questionable.

Towards the end of the "seventies" a succession of disasters at sea led to an agitation headed by Mr. Samuel Plimsoll, and directed against the practice of overloading vessels. Various conflicting proposals were made, and the controversy dragged on for some years, until at length, after much skirmishing between public opinion, the government, and the shipowners, and some abortive attempts to allay the storm by half measures, a Royal Commission was appointed to study the question and frame regulations for freeboard.

For the latter, three different bases were proposed. The officers of the Board of Trade contended that "height of platform" at which men would be safe from being washed overboard was the point to be chiefly considered. Some prominent professional men asked for a compulsory reserve of spare buoyancy, so that,

when water came on board, a vessel might be able to rise and shake it off again. A third school wished to make the strength of the structure to resist longitudinal bending the measure of the draft to which loading might be allowed, at any rate in certain classes of vessels.

The principles underlying these proposals were only partially grasped to begin with, although, in a vessel with, say, poop, bridge, and forecastle, freeboard is measured from the main deck, the men on watch will be on the decks of these erections in bad weather. To obtain the effective height of platform, the freeboard must be increased by the height of the erections (see Fig. 3). Spar and awning deck vessels are looked upon as having relatively light upper structures, in which the freeboard, measured from the uppermost continuous deck, must be greater than usual. These vessels were assumed to have no erections, and, when this was really the case, the effective height of platform became so much less than usual that captains often declined to load down to the mark allowed by the regulations. The height of platform provided was in fact too small. Nowadays spar-deck vessels, at least, usually have erections like other vessels.

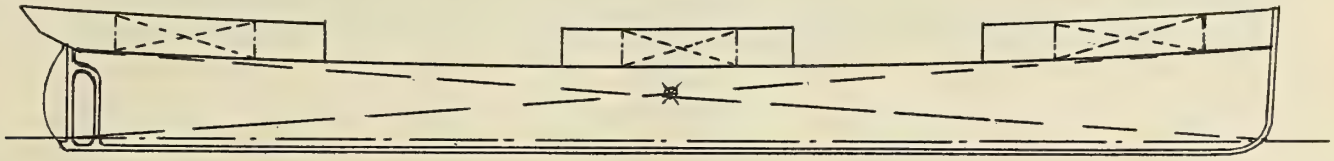


FIGURE 2.

A further mistake made in dealing with such vessels of lighter construction lies in the assumption that their bending strains vary with their displacements to different depths of immersion. Provided the cargo be so placed that the difference in the respective longitudinal distributions of weight and buoyancy is not excessive, the alteration in bending moment due to an increase or decrease of draft may be very small. The principal factor in the production of strain—the action of the waves—may hereby remain practically the same. The lightness of these vessels, it may be observed, is due to a deficiency of material at the place at which it is most needed, that is, at the top of the girder; and even if the reduction in the bending strains were admitted to take place, the construction is a disadvantageous one.

The spare buoyancy basis applies to vessels other than those with spar and awning decks, which in this respect are assumed to have something over. It is perhaps a question, whether poops and inclosed bridge houses might not be accredited with more buoyancy than the regulations assume them to have. However this may be, it is clear that the prevailing methods of freeboard assessment are a compromise between three distinct sets of requirements, which do not always run parallel. The reasonable way of dealing with these would be to determine the freeboard for each set separately, and adopt the largest of the values obtained. The amount of work involved would probably not be much greater than at present, and the result would certainly be more satisfactory.

As regards spar and awning deck vessels, these were created to evade the tonnage laws. If the present system of assessment were replaced by one that really fitted the circumstances, they would probably cease to be built. That the material of these vessels is not now properly distributed, is due to the circumstance that in the acts of Parliament relating to tonnage, spar and awning decks are declared to be light superstructures, and they have to fulfil this description.

The relation borne by the sheer of a vessel to height of platform is not always understood. Sheer ought not to be the "matter of taste" which it is generally considered. The side line of a vessel's deck should be about parallel to the line followed by the crest of a wave of her own length in passing along her side (see Fig. 3). The uneven distribution of the displacement in vessels of ship shape causes this line to rise higher at the ends than amidships—at the bow more than the stern.

Sheer is greater in proportion in short vessels than in long ones, because the wave that rises highest on a vessel's side is one of her own length, and, according to observation, the heights of full-sized ocean waves vary about as the square roots of their lengths—that is, are relatively higher, the shorter the waves.

Again, vessels with fine ends require more sheer than those with full ones, because the vertical or "heaving" motion is the greater with the former. This may readily be ascertained by a trial, in which the displacement of a vessel is calculated, first with the crest and then with the hollow of the wave amidships. If the wave crest in each case be taken at the same height above the keel, it will be found that the displacement is greater in the first case than in the second. When the wave hollow is amidships, the vessel must sink down until she finds her displacement. The momentum due to her vertical motion will, in fact, be such that she will be carried still further, and the real difference in the respective vertical positions of the wave crest in the two cases will be greater than the calculation of displacement would show.

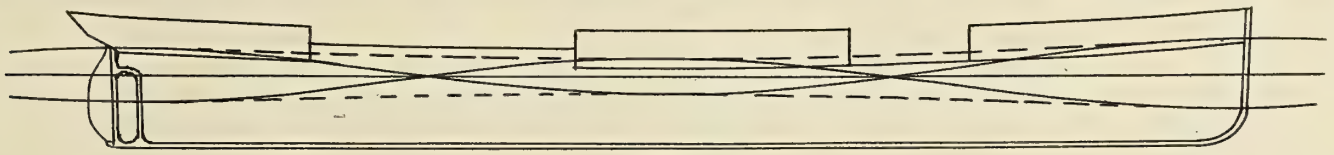


FIGURE 3.

The average allowances made for sheer in vessels of different sizes have been evolved from practice, and are probably nearly right; that is, they are such that the condition above referred to, of the path of the wave crest running approximately parallel with the deck, is in the average case fulfilled.

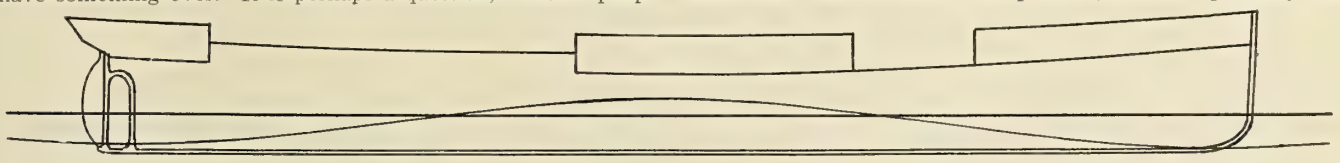


FIGURE 4.

The sheer is greater forward than aft, first because the forward motion of the vessel tends to increase the height of the waves that she meets, and to reduce that of the ones she leaves behind; and second because the stern is broader than the bow, and does not therefore sink so far into the water.

Since their provisions were first made compulsory, the freeboard regulations have been several times revised, but their general features as described above have undergone no material

alteration. As a substantial improvement upon the chaos which previously existed, they have given fair satisfaction to the various classes affected by them. It will be seen from the above, however, that they contain many imperfections, and that in some cases they unduly hamper the naval architect. And this is not all. They leave out of account some of the most important conditions of safety at sea. In connection with these the "under load-line" and the stability may here be referred to in brief.

The endeavor made on all hands to get more and more carrying power out of the parallelopipedon, combined with relatively smaller tonnage dues, led to a flattening of floors and an increase of coefficients of displacement, until vessels were produced which, in the light condition, swam like balloons upon the water, and could be steered only in a calm sea.

The draft of a vessel, when light, corresponds in some respects with her freeboard when loaded. It is important that passing waves should not lift her ends out of the water (see Fig. 4), and indeed that rudder and propeller should in all cases remain well immersed. As illustrated above for the freeboard, the draft here necessary should bear a certain proportion to the square root of the length of the vessel. To insure sufficient stability, it would probably be better to make the height from the middle of the bilge to the light line vary in the manner proposed, instead of the draft itself.

With regard to stability, it is difficult to lay down general rules, because so much depends upon the uncontrollable factor of stowage. Apart from this, it is influenced chiefly by the proportions borne by length to mean height and mean draft of vessel, respectively. It may be found feasible to fix upper and lower limits for these, at all events in particular trades, but a certain margin would in each case have to be left for possible abnormities of stowage. The question of stability, however, is one that must be discussed separately, and the same is the case with that of watertight subdivision, as a protection against a vessel's being sunk by collision or other mishap.

It seems a paltry half measure to take elaborate precautions against a few of the dangers of the sea; and to leave the rest out of account, because they appear difficult to deal with. Probably it would be better to disseminate information as to the principles which should be attended to in the design and working of vessels, and to leave legislation alone; but if the latter must be resorted to, care should be taken, on the one hand, that all the conditions be intelligently taken into account, and, on the other, that the natural development of the various types of steam and sailing craft be impeded as little as possible.

A Motor-Propelled Sea Serpent.

The motor boat *Togo*, fitted with a 24-horsepower motor, has been decorated until she presents an appearance such as that given in the illustration. With her speed of 18 miles per hour, she was used on the occasion of a native carnival held at Rotorua, Auckland, New Zealand, and it is stated that the effect produced upon the nerves of the natives of the district was powerful in the extreme. The boat has a length of 27 feet. She has been a consistent prize winner in the many races which she has entered in New Zealand waters. She was built by the Ailsa Craig Motor Company, Strand-on-the-Green, Chiswick, London, W.

THE AILSA CRAIG MOTOR BOAT TOGO, TRANSFORMED INTO A SEA SERPENT.

THE NEW SCOTTISH MONARCH.

BY FRANK C. PERKINS.

One of the most interesting and latest additions to the *Monarch* fleet managed by Raeburn & Ueree, Glasgow, is the *Scottish Monarch*. The official trials were held on the Clyde on November 15, 1906, when a speed of 13 knots was obtained. This vessel was, like all others of the company's fleet, designed by the company's marine superintendent, Capt. John C. Black, M. I. N. A., and built by Russell & Co., Port Glasgow. It is one of the most thoroughly up-to-date cargo steamers afloat in hull, form, machinery, cargo working appliances, and arrangements for the comfort of officers and crew.

The vessel measures 420 feet over all, 52 feet in breadth, and 30 feet in depth, with a block coefficient of 0.780, and measurement capacity of about 11,000 tons. She is constructed on the girder pillar principle, all hold stanchions excepting those for grain shifting boards being dispensed with. Her 'tween decks being 9 feet in height, she is an ideal vessel for the transport of coolies or troop horses; while her hatchways, being exceptionally large, 32 feet 6 inches by 18 feet, and each provided with two of Clark, Chapman & Company's latest type of 7 by 12 inch winches, permit of large and unwieldy pieces of cargo being handled with the greatest of care. A complete installation of electric lighting, in which there are no fewer than fourteen cargo clusters of five 32-candle-power lamps each, enables cargo to be loaded or discharged as rapidly by night as by day.

To enable the vessel to maintain a good average speed on long runs light, provision has been made for carrying 2,125 tons of water ballast, and with a view to eliminating all danger of damage to the tank margins arising in consequence of heavy seas on such runs, a special feature has been made of the bracket floor arrangement, all floors being bracketed to the tank top. The boiler room tank inside and on top, as well as the whole of the permanent bunkers, are coated with Wailes Dove's bitumastic enamels.

The propelling machinery, which is by D. Rowan & Co., Glasgow, consists of a set of triple expansion engines with cylinders 27, 44 and 73 inches in diameter, and a stroke of 48 inches. The cranks are of the built-up type and the shafting of forged steel carrying a solid propeller of nearly nine tons weight. Steam is supplied at 180 pounds pressure by two large single-ended boilers, each 16 feet 6 inches in diameter by 12 feet long, and fitted with Howden's system of forced draft.

There is a very full equipment of auxiliary machinery, which includes Weir's feed pumps and feed heater; a 20-ton feed evaporator; feed filter; steam turning gear; Morrison's winch condenser; Raylton, Campbell & Crawford's silent ash hoist, which discharges the ashes through the ship's side below the load waterline; and Cockburn's reducing valves. There is a large ballast donkey, to discharge nearly 200 tons per hour, and all the auxiliary and steam heating machinery is made to exhaust into the main condenser, the winch condenser, or to the atmosphere as may be required.

To fit the vessel for the carriage of coolies or horses, a fresh water distiller, capable of producing 4,000 gallons per day, has been provided, and there is a large donkey boiler of the marine type, 11 feet 6 inches diameter by 11 feet long, which supplies steam at 100 pounds pressure to the winches, windlass, and all auxiliary machinery.

The electric installation was provided by Telford, Grier and Mackay, Glasgow. The dynamo, which has an output of 185 ampères at 65 volts, is driven by a set of Howden's high speed compound engines of the inclosed forced lubrication type, running at 500 revolutions per minute. It supplies light to the whole of the living accommodation, navigation lamps, compasses, engine telegraph, engine room, stoke hold, bunkers and shaft tunnel.

BRIDGES OF STEAMSHIP SCOTTISH MONARCH.

THE STEAMSHIP SCOTTISH MONARCH, 5,043 TONS, ON ACCEPTANCE TRIAL TRIP.

The engine room and stokehold are particularly cool and airy, there being two 30 inch ventilators led down into the latter, and four of 25 inches into the former.

The steering apparatus consists of one Alley & McLellan heavy 9 by 9-inch steam gear, placed in the engine room, and one Hastier & Company powerful screw hand gear aft, operated by two 7 foot wheels. The rudder is of the single plate type, with forged steel frame hinged on the forged steel stern frame of the ship and has Wedgewood's vertical coupling. Connected to the quadrant is a powerful rudder brake designed by Captain Black to control the rudder in the event of the steering chains breaking at sea.

The officers, engineers, apprentices, and petty officers are berthed on the lower bridge deck, around which there is a steel bulwark 3 feet 9 inches high, with an awning deck carried over the accommodation, and terminating in a 10-inch curtain plate at the ship's side. Each room is an exact replica of the other, and measures 8 by 8 feet and 7 feet 6 inches high. Each is furnished in polished oak, and contains a bed with three drawers underneath, a chest of drawers, a wash basin, wardrobe, sofa seat, mirror, water basin and rack, Low's patent steam radiator, and electric light. All are upholstered in moquette, with inlaid linoleum on the floors, and damask port curtains. Each officer and engineer has a room entirely to himself, while separate bath rooms with washstands are provided for officers and engineers.

The saloon is also placed on the lower bridge, and is handsomely fitted in paneled oak with fluted pilasters, having carved capitals and with marble mantelpiece, tiled interior and oak over mantel, electric lights and electric fans.

The captain's room is in a steel house on the second or pilot bridge, and is a handsome apartment 16 by 14 feet and 7 feet 6 inches high, tastefully paneled on sides and roof, and furnished with polished oak in moquette upholstery, and pale blue curtains to match the white and heliotrope sides of the room. In this room is fitted up an electric alarm and steaming light indicator, which at once calls the captain's attention, should any of the navigation lights fail. Abaft this room, and in the same house, is the chart room, with a private entrance from the captain's room. As is usual in all the vessels of the *Monarch* fleet, this chart room contains no bed, or seat, the idea being to insure that the officer on watch have access to the charts at all times, by preventing the room's being used by anyone as a sleeping room.

The navigating bridge is carried over this house, and on it is built the wheel house, of steel construction, in which the helmsman is completely sheltered from bad weather. On the top of this wheel house is placed the standard compass, in an ideal position, far away from all local attraction. All the navigation instruments and the sounding machine are by Messrs. White, Thompson & Co., Glasgow. Easy communication between the bridge and the engine room is carried on by means of Chadburn's telegraph and Low's speaking tubes. Speaking tubes are also fitted between the captain's room and the navigating bridge.

The sailors and firemen are berthed in the top gallant forecastle, in large airy apartments 8 feet high, with 9-inch side lights, and are provided with galvanized iron bedsteads and good heating stoves, benches, lockers, etc. Separate bath rooms, with plunge and shower baths, are also provided for the sailors and firemen.

A hospital 12 by 12 feet by 8 feet high has been built in an isolated position aft, and contains four galvanized iron bedsteads, washstands discharging overboard, mirror, water bottle rack, table, seats, and an excellent heating stove, also electric light and an electric fan.

A considerable amount of spare gear is carried in readiness for any possible breakdown, including a spare propeller, propeller shaft, crank shaft, piston valve brasses, connecting rod, complete fan engine, spare parts of steering and dynamo engines, armature brushes and spare parts for winches.

The ship was built to take the highest class of the British Corporation, and after her trials proceeded to New York to load for Australian ports.

A Fast Run Through Long Island Sound.

The new steamer *Massachusetts,* the first of three freight steamers constructed by the Quintard Iron Works Company, of New York, and the William Cramp & Sons Ship & Engine Building Company, of Philadelphia, for the New England Steamship Company, made a trial trip from New York to Fall River on June 4, 1907, and succeeded in breaking all records down the sound.

When the contract was made for these steamers, the Quintard Company promised that they would carry 720 tons of freight on the main deck, that the propelling machinery would develop 7,000 horsepower, and that the steamers would make a speed of 18 knots. On this trial trip the *Massachusetts,* with a load of 800 tons on board, more than fulfilled these promises. She left Pier 18, North River, at 3:12 p. m., and the engines were stopped off the company's pier in Fall River at 11:00 p. m., thus making the run from dock to dock in seven hours and forty-eight minutes, an average of 23 statute miles per hour, or 20 knots.

It has always been claimed that the steamer *Metropolis* many years ago made the run from Pier 3, North River, to Fall River, in eight hours and forty-two minutes. The steamer *Puritan,* on June 8, 1899, made the run from the dry-dock at the foot of Pike street, East River, New York, to Fall River, in eight hours and twenty-four minutes, which fully equalled the claimed record of the *Metropolis.* The steamer *Priscilla* has never had the opportunity of making an especial fast run all the way from dock to dock, though she has made better time than the *Puritan* between intermediate points.

The steamer *Puritan,* on May 26, 1893, the day on which she went out to try her speed alongside of the *Richard Peck,* made the run from Stratford to Point Judith, a distance of 87¼ statute miles, in four hours and two minutes. The *Massachusetts* made this same run in three hours, thirty-four minutes and nine seconds. The steamer *Priscilla,* on July 21, 1894, when trying conclusions with the steamer *City of Lowell,* made the run from Throggs Neck to Little Gull, a distance of 95 statute miles, in four hours and thirty minutes. The *Massachusetts* made this same run in four hours and three minutes.

Of course all runs of this character are made with the tide more or less favorable, but to determine the actual speed through the water of the *Massachusetts,* her run from Execution Light to Point Judith was used. This run is 122½ statute miles, or 106.4 nautical miles. The steamer made this run in five hours, eight minutes and twenty-nine seconds, which gives a mean speed of 23.82 statute miles per hour, or 20.67 knots; making an allowance of 1½ knots for the tide, which under the circumstances is considered liberal, gives a speed through the water of 19.17 knots. The engines were designed for 125 maximum revolutions per minute, but on this run they averaged 133 for both engines, developing over 9,000 horsepower.

The *Massachusetts* is a twin screw steamer of 1,724 tons net and 4,029 tons gross, launched in April, 1907. She has a length of 375 feet, a beam of 54 feet 2 inches and a depth of 31 feet 6 inches. She is built of steel, with a double bottom and seven bulkheads. Propulsion is by four-cylinder triple expansion engines with cylinders 26, 43, 51 and 51 inches in diameter, and a stroke of 42 inches. Steam is furnished by eight single ended cylindrical return tubular boilers 14 feet 6 inches in diameter by 10 feet 10¼ inches long, at a working pressure of 185 pounds per square inch. The grate area is 484 square feet, and heating surface 17,797 square feet, making a ratio of 36.8 to 1.

Bids for New Battleships.

On June 20 the United States Navy Department opened bids for the construction of the two 20,000-ton battleships of the *Delaware* type. The bids were from four companies on the Atlantic coast, and included a considerable variety of bids, due to the inclusion in each case of alternative designs.

The department's design shows a ship with a length of 510 feet, a beam of 85 feet 2½ inches, a draft of 27 feet and a displacement of 20,000 tons. This ship it is proposed to propel by twin screws, at a speed of twenty-one knots, by means of reciprocating engines. The coal supply to be carried on trial is 1,000 tons, provision being made for a total supply of 2,300 tons. The battery consists of ten 12-inch guns of 45 calibers in length, mounted in pairs in five turrets, all on the center line, and so arranged that four guns may be fired forward and four aft, while the whole ten may be trained on either broadside. The secondary battery includes fourteen 5-inch rapid fire guns, and twelve smaller guns, besides two submerged torpedo tubes. The armor belt has a maximum thickness of 11 inches. On the department's design, the bid of the Newport News Shipbuilding & Dry-Dock Company is $3,987,000* (£819,275) this figure including hull, machinery and equipment, and the work of fitting armor and battery, but not including the price of the guns, their mounts or the armor. The bid of the Fore River Shipbuilding Company was $4,480,000 (£920,580). The bid of the New York Shipbuilding Company was $4,545,000 (£933,936). The bid of the William Cramp & Sons Ship and Engine Building Company was $5,100,000 (£1,047,981).

With one exception, all the alternative designs, which numbered eleven altogether, provided for ships propelled by steam turbines. That one exception was a bid of the New York Shipbuilding Company, in which reciprocating machinery of the bidder's design was designated, and the total bid in this case was $4,600,000 (£945,238). The turbine bid of this company covered Parsons turbines with separate cruising turbines, the figure being $4,530,000 (£930,854). The alternative bid of the Fore River Shipbuilding Company made provision for

*Accepted.

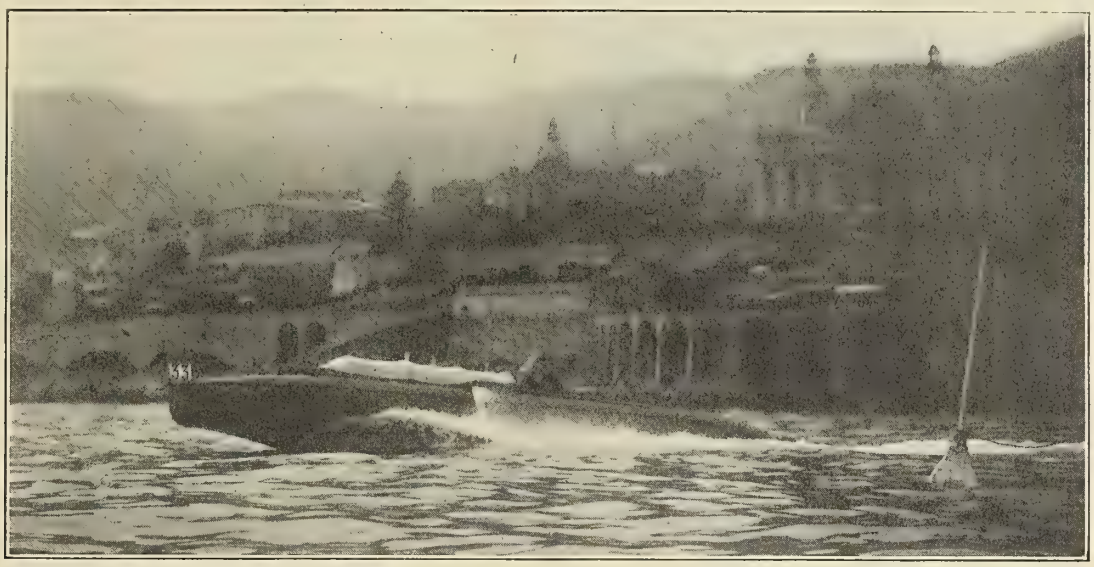
propulsion by Curtis turbines, which do not require cruising turbines. This bid was $4,377,000* (£899,614). The two alternative bids of the Cramp Company contemplated the use of Parsons turbines, the bids being respectively $5,050,000 (£1,037,707) and $5,030,000 (£1,033,597), in each of which cases an additional $50,000 (£10,274) was required for cruising turbines. The Newport News Company submitted six alternative bids, all contemplating the use of Parsons turbines and Thornycroft-Schultz boilers. These bids ranged from $4,050,000 (£832,220) to $4,125,000 (£847,632). All of the above alternative designs contemplated the use of the department's hull and equipment.

It should be noted that the bid of the Newport News Company on the department's designs is $3,000 (£616) less than their successful bid in 1902 for the construction of the battleship *Louisiana*, of 16,000 tons, and of a guaranteed speed of eighteen knots, the actual speed on trial trip having been 18.82 knots. It should also be noted that this bid is $1,113,000 (£228,706) less than the bid of the Cramp Company for identically the same thing.

*Accepted.

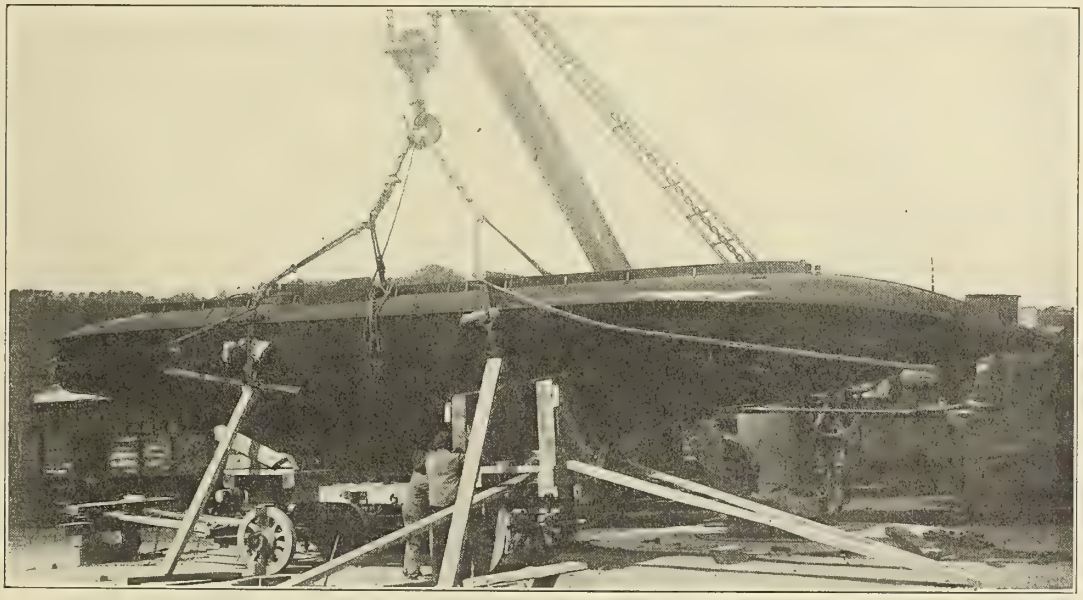
The High Speed Motor Boat Mercedes W. N.

The peculiar hull form of the *Mercedes W. N.*, equipped with a 180-horsepower engine, is shown in the accompanying views. This boat has made some excellent runs at Monaco and Nice, France. She was constructed by the celebrated European firm of the same name, at Baden near Vienna, Austria, the same firm having constructed the high speed motor boat *Mercedes-Paris*, equipped with a six-cylinder motor and having made a speed of 30 kilometers (18.64 miles) per hour over a distance of 1,100 kilometers (683 miles).



THE MOTOR BOAT MERCEDES W. N. AT FULL SPEED AT MONACO.

This newer boat has a total length of 12 meters (40 feet) and a width of over 2 meters (nearly 7 feet), the depth measuring 1.1 meters (3.6 feet). The six-cylinder engine develops 150 horsepower when operating at a speed of 1,050 revolutions per minute. The cylinders are 175 millimeters (7 inches) in diameter with a stroke of 145 mm. (5.7 inches). The engine is provided with low tension sparking devices of the Magneto-Simms-Bosch type, also with high tension igniters of the Magneto-Eisemann design. A set of storage batteries is also provided. The carburetor is of the Mercedes design, having an automatic regulator.



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The edition of this issue comprises 6,000 copies. We have no free list, accept no return copies and issue only enough to supply the regular demand.

The Japanese War Cloud.

Much speculation is being indulged in regarding the immediate future of the relations between Japan and the United States. While there is little probability of immediate serious trouble, it is pertinent to inquire into the strength of the two navies. There are in commission in the United States navy twenty-two first-class battleships, aggregating 291,679 tons. These ships carry a total of eighty-eight guns of 12 and 13 inches, all of which are available on the broadside. There may also be trained upon a single broadside no less than seventy-four 8-inch; thirty 7-inch and eighty-one 6-inch guns; making a total broadside discharge of 51 tons of metal.

The Japanese battleships, including five taken from the Russians, number thirteen, with an aggregate of 180,140 tons, and a total broadside of forty-four 12-inch, twelve 10-inch and seventy-eight 6-inch guns, giving a total of 22.8 tons of metal at one discharge.

In armored cruisers the American navy has about the same relative advantage, so far as numbers and displacement go; but the Japanese ships are in general more powerfully armed than the American, which would tend to partially even up the forces of swift vessels.

The Marine Steam Turbine.

Among the papers presented at the summer meeting of the forty-eighth session of the Institution of Naval Architects, which was held in connection with the International Congress at Bordeaux, was one by Messrs. Parsons and Ridsdale upon "Practical Points in the Application of the Marine Steam Turbine." The paper is concerned principally with the maneuvering qualities of vessels fitted with Parsons turbines, with comments upon coal consumption, weight of machinery and arrangement of machinery in the vessel.

"In the actual handling of a steamer in crowded waters, in narrow channels, in entering harbors, and in approaching piers and landing stages, or in docking and undocking, the reliability of her reversing arrangements —the perfect and prompt obedience of the machinery—is the primary consideration. It has been stated by a well-known shipowner in a discussion on a paper a few years ago that 'more cases of accidents come up at Lloyd's Classification Committee through striking dock walls and pier-heads than from any other cause.' Such accidents must be principally due to the engines themselves failing to respond quickly to the orders from the bridge. The relative absence of accidents from such causes with turbine steamers goes to prove that the certainty in handling is far greater than in the case of reciprocating engines; and if the man in charge knows that his ship can be brought up with absolute certainty within a distance ascertained by experience, he quickly acquires great confidence in handling her, whatever that distance may be."

Figures of actual results with various vessels propelled by turbines have shown that in most cases where they are running at not more than 11 knots they can be stopped within a distance equal to about their own lengths, the period of stopping being frequently less than one minute. At higher speeds, the distance and period are both largely increased. Thus, at 17 knots a 400-ton destroyer requires nearly three lengths. This may be compared with three lengths at 14.5 knots for the United States battleship *Indiana* with reciprocating engines. A direct comparison is had between two German cruisers, of about 3,000 tons displacement, one of which is fitted with turbines and the other with piston engines. It was found that at a speed of 5 knots the turbine-propelled ship stopped somewhat quicker than the other, but that at a speed of 11 knots there was a slight advantage in favor of the reciprocating vessel.

As a general proposition, there is no necessity for bringing a ship to rest on a straight course in the shortest possible distance and time. A maneuver of this sort is usually entered into for the purpose of avoiding a collision, and the helm is used, as well as the reversing of

the engines. In fact, a committee of British naval engineers in 1877 reported that by steaming *ahead* and using the rudder a collision might be averted which would have been unavoidable with full speed astern on a straight course. From this point of view, comparisons are given in the paper of the turning circles of various vessels, and it is interesting to note that the turbine steamer *Viking,* 361 feet long, when running at 20 knots, has a turning circle with a diameter of 1,475 feet. Compared with this, we have the American battleship *Nebraska,* 435 feet in length, which at 19 knots has a turning circle of 1,050 feet diameter. With the *Viking,* the circle is about 4.1 lengths of the ship, while with the *Nebraska* it is about 2.4 lengths.

Service coal consumption comparisons in torpedo boat destroyers of similar design, one fitted with turbines and the other with reciprocating engines, show very similar results up to 21 knots. With cruisers of identical size and type, fitted respectively with the two types of machinery, the result seems to favor very largely the turbine engines, as regards coal consumption. In one comparison the two cruisers covered a distance of 1,380 nautical miles side by side in ninety-two hours, or at a speed of 15 knots. The turbine cruiser consumed 245 tons of coal as against 297 tons for her consort, this being an increase of 21 percent. In another comparative test, the two cruisers covered 2,090 nautical miles in 132 hours, at 15.8 knots. The turbine cruiser used 366 tons of coal as compared with 416 tons, the difference being nearly 14 percent. A comparison of full speed results gives figures even more striking than this.

"For given speed and horsepower and efficiency there is very little variation in the weight of turbines, whether for mercantile or naval purposes. On the other hand, reciprocating engines will vary very considerably, as, for instance, in the case of a large cruiser and an Atlantic liner of the same power and speed, the mercantile vessel will have engines 50 percent heavier than the warship. If we compare these two types of vessels with turbine engined ones, it will be found that the turbines for full power will weigh nearly the same in both liner and cruiser; but in the case of the warship, as the complete installation generally includes also cruising turbines for the reduced speed, the total weight will be actually heavier than that for the mercantile vessel, thus reversing the case of the reciprocating ships.*

"For similar engines, with the same piston speed, the power of reciprocating engines varies about as their $(\text{weight})^{\frac{2}{3}}$. With turbines for the same power the weight varies considerably for different speeds of ship, the turbines being relatively much heavier for low than for high-speed vessels. It will generally be found when comparing turbines and reciprocating engines that the weight and cost of the turbine installations begin to exceed those for reciprocating engines at about the same point as that at which the steam consumption of the turbine becomes too high for practical application, i. e., in ships where the propulsive conditions and speed of ship begin to rule the turbine out of court. Thus we may say that up to the present time, for all mercantile applications, the turbine has been lighter than ordinary reciprocating engines to give the same speed of ship. In some cases this saving has exceeded 30 percent, while in others the weight has been very nearly equal.

"In battleships and cruisers turbines are of about the same or less weight than reciprocating engines. It is only in vessels of the destroyer and torpedo boat class that the reciprocating engine is able to beat the turbine on the score of weight, with this difference, that the reciprocating engine becomes so frail as to have but a very limited capacity for full-speed running, and can indeed be run at full speed only by the aid of the most careful nursing. On the other hand, it may be justly claimed for the turbines of a destroyer or torpedo boat that they require no nursing, and are always as ready for continuous running at full power as those of a larger ship. It has been stated above that turbine weights cannot be much varied for constant conditions. Exception should be made to this statement so far as weights are influenced by test and boiler pressures. It has been found that the boiler pressures adopted in recent years for reciprocating engines are generally higher than are necessary in similar vessels fitted with turbines, in order to secure the best and most economical results; but we wish here to point out the influence of specified test pressures on turbines, and as about 40 to 45 percent of the weight of the turbine is on an average directly affected by the test pressure specified, and as this proportion of the weight varies in direct ratio to the test pressures for equal stresses in material, it is seen how largely the total weights of the turbines are affected by the boiler pressure."

The statement that in torpedo boats and destroyers the reciprocating engine for a given power is apt to be found lighter than the turbine, comes as something of a surprise. When we remember that the little *Turbinia,* 100 feet long and of 45 tons displacement, developed 2,200 horsepower on a machinery weight of 22 tons, and then compare this result with the best obtained with reciprocating engines in torpedo boats of the United States navy, which shows approximately 50 horsepower per ton of machinery, the statement made in the paper seems to be at direct variance with previously accepted ideas on the subject. The fact that there are in the American navy no torpedo vessels of as much as 2,200 horsepower, with a displacement of under 140 tons, or more than three times that of the *Turbinia,* and that in nearly all of these vessels from 40 to 50 percent of the total displacement is taken up by machinery weights, including auxiliaries, etc., seems to be further evidence along the same general lines.

*This comparison leaves out of consideration the heavier condensers, pipes, and auxiliary machinery usually fitted in merchant ships.

American Shipbuilding in 1906-07.

The total tonnage of merchant vessels built in the United States and officially numbered by the Bureau of Navigation during the fiscal year ended June 30, 1907, was 1,364 vessels of 510,865 gross tons, the largest in half a century, and exceeded only twice in American history. Construction in 1855 amounted to 583,450 gross tons, in 1854 to 536,046 gross tons. In those two years the tonnage built in the United States greatly exceeded the tonnage built in the United Kingdom.

In the past fiscal year steel steam vessels built in the United States numbered 122 of 360,665 tons, by far the greatest tonnage of this description in our history, but only about one-fifth the tonnage built in the United Kingdom. The average tonnage was 2,956. Of these steel steamers, 47 of 238,713 tons, an average of 5,079, were built on the Great Lakes; the *Le Grand S. De Graff*, 7,971 tons, being the largest yet built for those waters. Fifteen new lake steamers are each over 7,000 tons. In 1903 the largest steamer built on the Lakes was 5,600 tons.

The total tonnage and average size of steel steamers built for the coasting trade are the largest in our history. On the seaboard 24 ocean steamers, each over 1,000 gross tons, aggregating 98,028 tons and averaging 4,085, were built, the largest being the *Mexican*, 8,579 tons, for the new west coast Hawaiian trade via the Tehuantepec Railway. Only two steamers, *Havana* and *Saratoga*, each of 6,391 tons, operating under the Ocean Mail Act of 1891 to Havana, were built for the foreign trade.

COMPARATIVE STATEMENT

	1906			1907		
	Ships	Tons	Aver.	Ships	Tons	Aver.
Steamers	825	311,512	378	813	397,841	489
Sailing	254	36,833	145	176	25,736	146
Unrigged	384	73,399	191	375	87,288	233
Total	1,463	421,744	288	1,364	510,865	375
Steel Steamers	109	281 741	2,585	122	360,665	2,956

Four years have now elapsed since a square rigged vessel was built in the United States, and the increase in steam tonnage is accompanied by a decline in the building of schooners. A relatively new type, the schooner equipped with auxiliary motor power, is appearing.

The (Curtis) turbine-propelled steamer *Creole*, of the Southern Pacific Line, described in our columns last October, has been placed in service between New York and New Orleans.

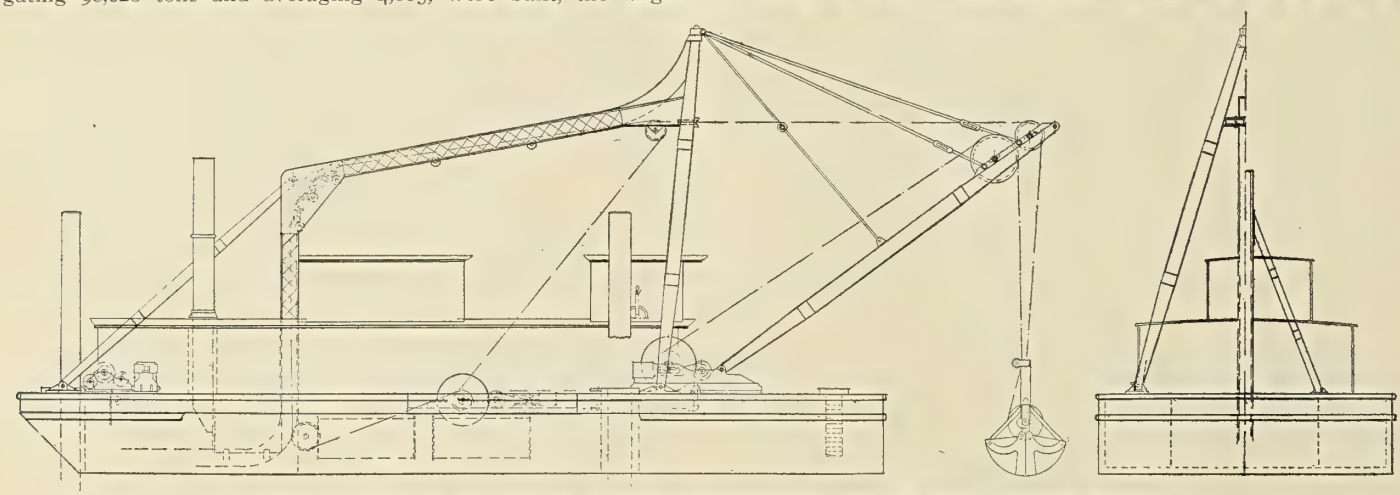
ENGINEERING SPECIALTIES.

Toomey's Hoisting Apparatus on a Large Dredge.

A floating dredge that has been used very satisfactorily on smaller work has recently been designed for a large capacity in heavy work, and presents some good special features of arrangement and operation. It has a hull about 130 feet long and 45 feet wide, with a boom 66 feet long on centers, which carries a clam-shell or orange-peel bucket of 10 cubic yards capacity. The weight of this bucket empty is about 17 tons in air, and its weight when filled with wet mud is about 32 tons in air, and only 22 tons in water.

The difference of 10 tons, and the weight of the empty bucket, cause a great irregularity in the stresses developed by hoisting. To equalize these stresses and to make the service of the hoisting machinery work more uniform, the bucket is provided with an adjustable variable counterweight, arranged to take up about 12 tons of its weight and to throw the full weight on the bucket when below the surface, so that it will sink rapidly in the material for filling. This compensating arrangement permits a more uniform operation of the engines, to promote economy of work and maintenance.

The boom has a horizontal radius of 53 feet, which gives it a reach of 22 feet in advance of the dredge and 30 feet on each side, thus enabling it to command a considerable area in one position of the dredge. The heel of the boom is pivoted to a turn table 20 feet in diameter, on which is seated the single drum main hoisting engine, in the same vertical plane as the boom, thus providing a direct line for the hoisting rope and effecting an estimated economy of 20 percent in expenditure for power and wear. The point of the boom is supported in a fixed vertical position by steel rods pin-connected to it, and to a swivel at the top of the shear legs 53 feet high. The feet of these legs clear the turntable and have fixed pivots on the deck.



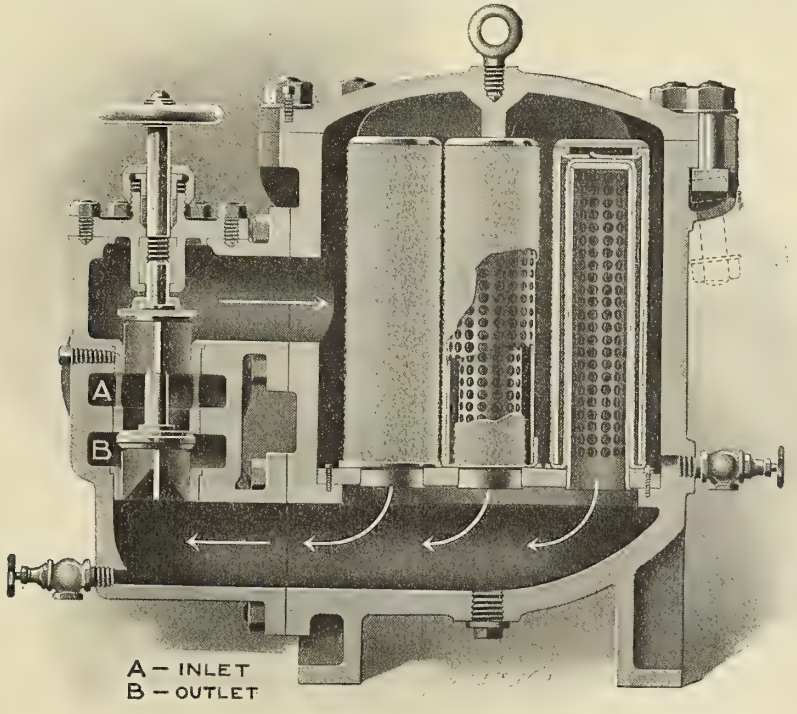
TEN-CUBIC-YARD BUCKET DREDGE WITH VARIABLE COUNTERWEIGHT, BUILT BY TOOMEY BROTHERS COMPANY.

The shear legs are inclined slightly forward and are attached to a longitudinal strut about 55 feet long, on the outer line of the dredge. The opposite end of this strut is supported on a vertical column 34 feet high, and is anchored by a small girder back stay reaching to the stern of the dredge, and two side braces. The longitudinal strut serves as a track for counterweights attached to a steel cable passing between horizontal guide sheaves at the shear legs, and thence over a sheave at the end of the boom and down to the bucket, which is supported by it and by another line led over a second sheave at the point of the boom, and directly back to the main hoisting engine.

The proportion of the lines is such that when the bucket is in the water, the counterweight is supported by the inclined strut on a track graded sufficiently to insure positive motion in the counterweight without putting much tension on its rope. Before the top of the bucket rises to the surface of the water, the counterweight reaches the inclined strut, and as the bucket continues

to rise, it abruptly descends vertically, throwing its full effective weight on the hoisting line, and relieving the engine until the bucket again descends below water level, and the counterweight runs away from the vertical to the inclined track and its tension on the hoisting rope is eliminated. The lower counterweight track is extended aft from the foot of its vertical hoist, where it can remain in equilibrium at the bottom of the dredge if necessary for inspection or adjustment. By this arrangement, and the location of the hoisting engine on the turntable, the counter balance is always effective, and the bucket can be operated at full radius on either side of the dredge without causing excessive list.

The dredge is anchored in the usual manner by the two vertical spuds forward and one aft. The spuds are operated by three vertical engines, with worm gear on first shaft, with winch-heads and drum for hauling purposes. The second shaft is similar to a ship windlass for hoisting spuds. The engine on the turntable hoists the closing part of the bucket; the other drum for controlling the weight is between the two drums that swing the turntable, but in case the bucket grabs some wreckage, the bucket can be opened and hoisted. The two outside drums turn the turntable. Each has a friction drum, and it is not necessary to reverse the engine, for one drum winds as the other unwinds; the one lever takes care of both frictions. The dredge is about one-fourth smaller than other dredges of equal capacity. Special care has been taken to arrange the machinery as compactly as possible and to simplify it, thus securing a machine that is exceptionally cheap and convenient in its operation. It has been developed and is placed on the market by the Toomey Brothers Company, of Guilford, Conn.



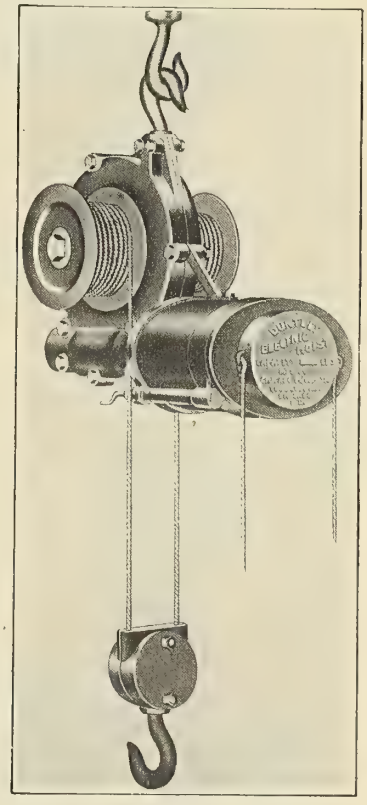
A Feed Water Filter and Grease Extractor.

In the Blackburn-Smith feed water filter, built by James Beggs & Company, New York, water from the feed pump enters the inlet, passes into the upper or filtering chamber, through the filtering cartridges into the bottom chamber, and thence through the outlet to the closed heater or boiler. The water passes through the cartridges with little friction, but, in the course of time, as the foreign matter accumulates on the filtering material, some resistance will result. This resistance is shown by the reading of pressure gages connected to the filtering and outlet chambers. When the difference of pressure as shown by the gages increases to 20 pounds per square inch, the filter should be cleaned. A water relief valve automatically prevents the building up of excessive pressure in the pump discharge line.

All the main valves are on one stem, and one movement of the hand-wheel causes the filter to be put in operation or by-passed. The lower disk is double beat, and its position determines the flow through the filter. The number of cartridges varies with the size of the unit. Each cartridge consists of two concentric cylinders of heavy perforated brass tubing covered with linen Terry. The filtering media conform to the shape of the cartridges, the closed end being drawn down to a nice fit over the inner cylinder, reversed over the outer cylinder, and the other end tucked in and clamped by a brass cap. This construction compels a double filtration, so that any matter which gets through the first layer of Terry is sure to be caught in the second layer.

On by-passing, opening the drain and lifting the filter cover, all the filtering media can be removed or renewed with little effort. The foul medium of each cartridge is slipped off with one motion, and fresh slipped into place and clamped by a gentle downward pressure.

The capacity of this filter varies according to the amount of surface of filtering material; 7,500 pounds of water per hour may be filtered through a 1½-inch feed line, and the quantity increases up to 250,000 pounds per hour for a 6-inch line.

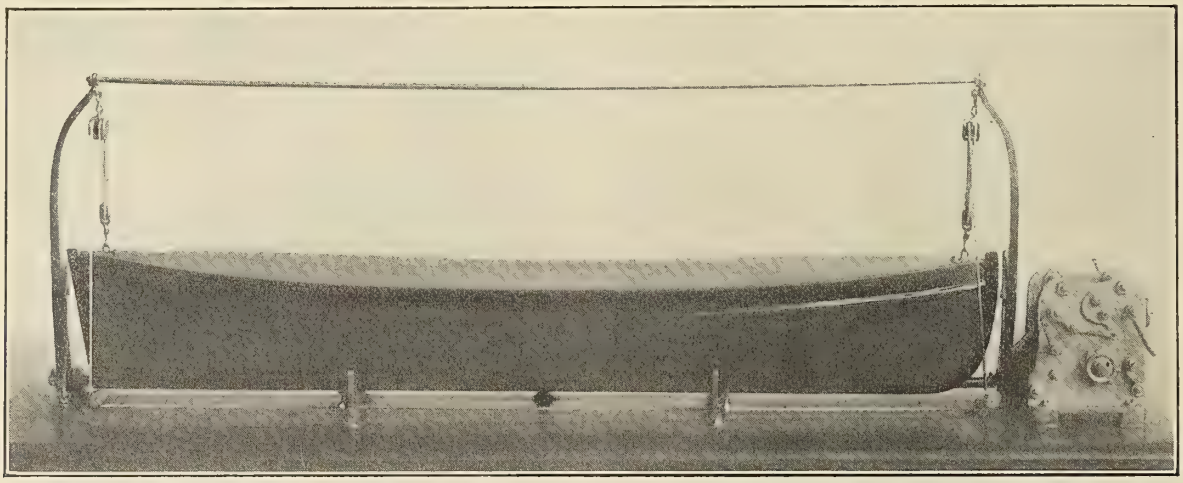


Portable Electric Hoists.

The Duntley portable electric hoists are made in sizes from 250 pounds up to 2,000 pounds capacity. In designing these hoists it has been the desire of the manufacturers to make a light, portable hoist, and with this end in view a special motor has been designed for each size. The advantage of this is obvious, as no unnecessary weight is put on the hoist, and ample power is provided for doing the work of each in accordance with its rating. The hoists are of the worm gear type, with two hoisting drums, one located on each side of the gear.

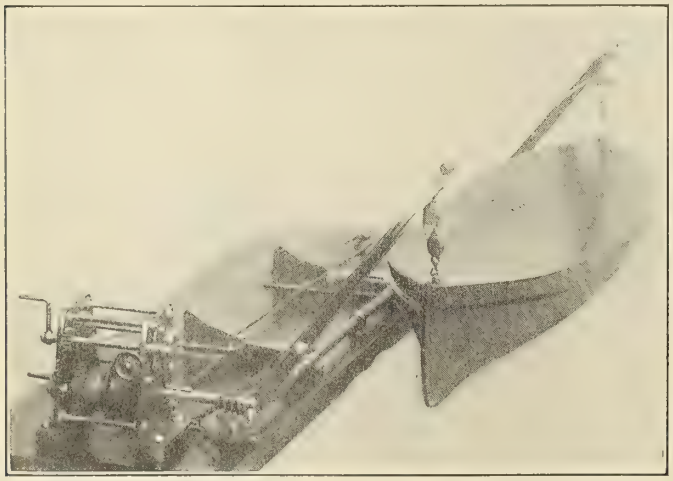
The worm is provided with roller thrust bearings and runs in oil. It is driven through a planetary system of gearing similar to that used in the electric drills. A very simple dynamic brake is used, by means of which the hoist can be stopped instantly, either in going up or coming down with full load. The control is located at the outside end of the motor, and is handled by means of two cords running within reach of the operator. The hooks are provided with a ball-bearing swivel. The standard drums are arranged for a lift of 15 feet, and are sufficiently wide so that only one wrap of the cable is necessary on the drum. Where a greater lift is desired the drums are widened out, and can be furnished capable of lifting up to 25 feet.

The hoists are manufactured by the Chicago Pneumatic Tool Company, Chicago, Ills.



A New Boat Launching Device.

One of the most practical pieces of apparatus which has come to our attention in some time is a scheme for launching life boats from ships, invented by John Boag, of 301 Kearney avenue, Kearney, N. J. Mr. Boag, who is chief engineer of the United States army transport *Kilpatrick,* has evolved a device whereby one man can perform unaided the operations of swinging the boat out and lowering it into the water. The davits, which are of channel section, are sufficiently far apart to permit the boat to swing full length between them, and are connected together at both top and



bottom. At the top is an extra heavy gas pipe, mainly for stiffness. At the bottom is a heavy shaft running through the bases of the davits, and rigidly secured to them. One end of this shaft contains a quadrant with teeth meshing in those of a worm gear. This gear is actuated by means of a train of spur gears and a crank handle, in a small hand winch outfit located near one end of the boat. As ordinarily swung, the davits lean inboard far enough to leave the boat fully within the line of the hull; when they swing out, however, they come to an angle of about 55 degrees with the horizontal, at which point a link brings them up, and takes the strain off the gearing.

The falls are carried from blocks on the deck to a double drum winch within the mechanism, one line for each drum. As the drums are of the same size, this insures the lowering of both ends of the boat equally. When the boat swings up and out, the distance between the block on deck and the block at the head of the davit is immediately increased, and the boat is hoisted up clear of the chocks, the outer halves of which can readily be dropped out of the way, from the inner side of the boat. The boat is lowered by its own weight operating on the drums, and the speed governed by a strap brake provided with a threaded head, and thus entirely within the control of one man. The inventor states that with this device it is possible for one man to take a boat from the chocks and put it into the water within twenty seconds.

To raise the boat, a train of spur gears is thrown into mesh with the drums, by means of an eccentric or a clutch, and two men can readily raise the boat with two men in it. For the loaded boat, four men would probably be necessary. The winch outfit is 40 inches high, and measures 32 inches square on the base. The cranks have an arm of 15 inches.

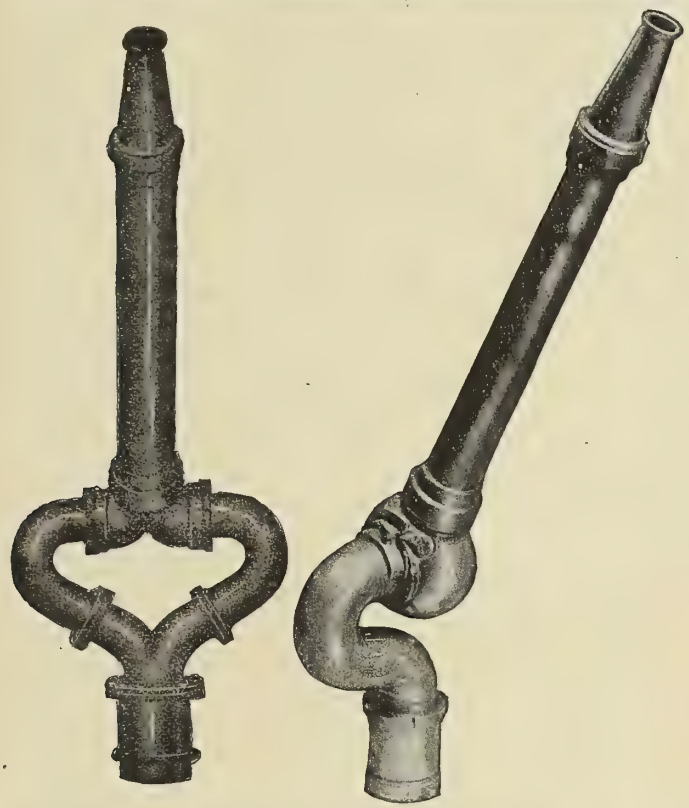
The Glazier Universal Nozzle for Marine Use.

This is a flexible nozzle and has much to recommend it for general use on fire tugs, steamboats, docks, and in and around shipyards. It marks a distinct advance over the old-fashioned type of nozzle, in that it can be handled by one man, either at the end of a line of hose, or attached to a stationary standpipe. It is constructed to rotate in any arc of a sphere, and has a much larger range in consequence than can be obtained by other methods. Its use saves time, room, attendance and the expense of hose connection when attached to standpipe.

The double arm nozzle is designed to be attached directly to a stationary standpipe, which on tugboats and such craft is usually placed on the pilot house, where it is most convenient and always ready for instant service. The nozzle will not back lash, and can be turned in any direction, where it will remain rigid and stationary. It can even be laid down at an angle, with the heaviest pressure, and left to care for itself.

Constructed of brass, the Glazier nozzle will deliver streams of from 1⅛ to 5½ inches in diameter, depending on the capacity of the pumps. Being universal in movement, with double ball bearings and with joints packed automatically, it will not leak or lock under pressure. By reason of the simplicity in design and construction, friction is reduced to a minimum, and on that account a greater throw can be given direct from standpipe than with the ordinary nozzle attached to hose.

S. F. Hayward & Company, 20 Warren street, New York, report its use on the pilot houses of all the recent tugs of the Erie Railroad, Hudson Towing Company, Baltimore & Ohio Railroad, Central Railroad of New Jersey, Delaware, Lackawanna & Western Railroad, Merchants and Miners Transportation Company, Pennsylvania Railroad, as well as the boats of the Standard Oil Company. It has been adopted by the United States government, the New York Fire Department, and the Department of Correction, and is approved by the National Fire Protection Association under the rules and requirements of the National Board of Fire Underwriters.



TECHNICAL PUBLICATIONS.

The Blue Book of American Shipping. Size, 7¼ by 10 inches. Pages, 538. Illustrations 10. Cleveland, Ohio, 1907. The Penton Publishing Company. Price, $5.

This is the twelfth annual edition of a marine and naval directory of the United States, giving statistics of shipping and shipbuilding in America, with lists of ship owners, ship, engine and boiler builders, power and pleasure boat builders, manufacturers of gas and gasoline engines, naval architects, marine engineers, vessel masters and members of various organizations made up from the navy and the merchant marine. Particulars are given of American and Canadian steam and sail vessels on the coasts, rivers and great lakes, with the names and addresses of owners; particulars of boilers and engines of American coast and lake vessels; particulars of vessels of the United States navy, dry-docks, maritime exchanges, ship chandlers, government officials connected with shipping in the United States and Canada, admiralty lawyers, wrecking companies, steamship lines, and public works contractors of the United States, together with lists of ship owners, ship builders, naval architects and marine engineers of Europe.

The quantity of material contained is very great, and consists in large measure of tables. Particular attention is given to the development of shipping on the Great Lakes of the United States and Canada, and the work as a whole forms an extremely useful reference for anyone who may have occasion to look up any subject of this general nature.

Denatured or Industrial Alcohol. By Rufus F. Herrick. Size, 6 by 9 inches. Pages, 516. Figures, 163. New York, 1907. John Wiley & Sons. Price $4, net (16/6 net).

This is a treatise on the history, manufacture, composition, uses and possibilities of industrial alcohol in the various countries permitting its use, and the laws and regulations governing its production and use. Concise tables, methods of use and notes are given for the convenience of the engineer, chemist, the manufacturer of alcohol, or of apparatus for the making or using of alcohol, including alcohol motors, engines, illuminating lamps, and heating and cooking stoves.

The effect of the excessive internal revenue tax on alcohol in the United States, which has been gradually increased from 1860 until at the present time it is $2.08 (8/6) per gallon, has been to prohibit the use of alcohol for industrial purposes. In the meanwhile wood alcohol, being free of tax, and, therefore, much cheaper, was introduced for such uses, and merely replaced ethyl alcohol, which is much better for the industrial purposes to which alcohol is placed, but was heavily taxed. The denatured alcohol, however, being immensely superior to wood alcohol, and having been recently made free of taxation in the United States, has unquestionably a large future before it, and will probably soon almost completely displace the wood alcohol, besides extending the total use of alcohol as a power producer and fuel. The whole problem of denatured alcohol in the United States is in a pioneer state of development, and for that reason the alcohol-using apparatus described in this volume is largely of foreign make. Thorough investigations, however, have been made on the use of alcohol by American manufacturers of internal combustion engines, and results would seem to indicate the placing upon the market at no distant date of thoroughly reliable apparatus for the use of the new fuel.

The subject is taken up in large detail, and the portions devoted to apparatus are profusely illustrated. The last 123 pages of the text form an appendix, giving the regulations of various countries concerning the use of alcohol for power and other purposes; together with a list of the most important patents during the last twenty years, along the line of processes and apparatus for the manufacture of alcohol. An eighteen-page index makes the work readily accessible for reference.

Schiffskessel. By Walter Mentz. Size, 6½ by 9¼ inches. Pages, 306. Figures, 222 and five plates. Munich and Berlin, 1907. R. Oldenbourg. Price, 12 marks.

The work begins with the historical development of ships' boilers, and after a consideration of fuels, heating and grate surfaces, draft and water and steam capacities, the subject of the placing of boilers in groups on board ships is taken up, a large number of drawings being presented to show typical cases in actual practice, in both cylindrical and water-tube boilers, and in war ships and the mercantile marine. The material of which the boiler is composed is given careful attention, and specifications presented to be followed in construction. The laying out of the boiler, and the bending of the various plates as required, follow, after which is taken into consideration riveted joints, as applied to boilers. Furnaces are described in some detail, and the various corrugated patents outlined. Staybolts and stay tubes, as well as crown bars, are discussed, both in a descriptive way and from the theoretical standpoint. The next chapter takes up the fitting of tubes.

The twelfth, thirteenth, fourteenth and fifteenth chapters are devoted to watertube boilers, and numerous types are described and illustrated, including both the large tube and the small tube boilers, and also the horizontal, vertical and inclined types. Artificial draft, superheaters, boiler lagging, uptakes, smoke pipes, and boiler fittings are treated in considerable detail, the last chapter being devoted to the handling of the boiler.

Practical Advice for Marine Engineers. By Charles W. Roberts. Size, 4⅞ by 7¼ inches. Pages, 206. Figures, 82. London, 1907. Whittaker & Company. Price 3 shillings net. New York, The Macmillan Company. Price, $1.50.

This is the second edition of a work which was placed before the public in 1894, the original object having been to collect a few practical hints regarding the management of marine engines and boilers, in the hope that they would be of value for junior engineers and others having to deal with steamship machinery. In the present edition, the work has been thoroughly revised, and enlarged by considerable additions, the subject having undergone a marked modification during the intervening period.

The subject matter is divided into six chapters, covering respectively The Engineer, In the Stokehold, The Donkey Boiler, In the Engine Room, Down the Tunnel, and The Propeller. The illustrations are numerous, and clear enough for easy comprehension, consisting almost entirely of line drawings dealing with the various portions of the machinery under consideration. The advice given is that from a man at sea, and, as such, is thoroughly practical in every respect. A large portion of the information deals with repairing and refitting the different parts, and sufficient detail is given to indicate the general scope of the work in all particulars.

Indicator Diagrams for Marine Engineers. By W. C. McGibbon. Size, 7¼ by 9½ inches. Pages, 182. Figures, 197. Glasgow, 1907. James Munro & Company. Price, 7/6 net.

After describing and illustrating a number of types of indicators in common use, as well as the original indicator of James Watt, the subject of diagrams is taken up, and a description given of the method of obtaining an indicator diagram, and of the meaning of the diagram as obtained. Then the subject is taken up of rigging the indicator upon the engine, and arranging the cord motion to show correctly the piston displacements. The mean effective pressure as derived from the indicator card may be obtained either by the use of a planimeter, or, by dividing the length of the card into some definite number of equal parts, and then measuring the mean altitude of each part, the average may be easily obtained.

The laws relating to pressures and volumes are stated, and methods given for drawing isothermal and adiabatic expansion lines and comparing them with actual expansion lines. The subject of combined cards is given some attention, as well as the effect produced on diagrams due to sequence of cranks. A description is given of Zeuner's valve diagrams, and the method of analyzing from them the operation of the valve. The subject of the Bilgram diagram, however, from which designing can be done, has not been touched upon.

Computation of horsepower from the diagram, balancing of the engine, and other subjects of kindred nature are given adequate attention, while one chapter is devoted to the subject of defective diagrams and the correction of the defects in either the indicator or the engine. Tables of the hyperbolic logarithms of numbers, the elements of circles and the properties of saturated steam complete the volume.

Practical Mathematics for Young Engineers. By F. Hovenden. Size, 5 by 7½ inches. Pages, 144. Figures, 27. Glasgow, 1907. James Munro & Company. Price, 2/6 net.

The work is really an arithmetic, with practical applications to problems in mensuration and mechanics. In the preface, the writer bewails his inability to find an arithmetic which explains the simple rules in a clear manner, and, at the same time, limits their applications to the requirements of the practical draftsman and mechanic. The book has, therefore, been compiled for the use of apprentices who intend to become marine engineers, and is designed to form a solid ground work from which to build further along the mathematical line. Numerous practical problems are given, with answers.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 381.—(1) With a crank pin 10 inches in diameter and 15 inches long; cylinder, 60 inches in diameter; what would be the pressure on projected area per square inch on crank pin with 140 pounds steam, main boiler?

(2) With same dimensions of cylinder and pin; steam 120 pounds and 30 pounds back pressure in the receiver; what would it be per square inch of projected area of crank pin?

(3) From same dimensions of cylinder and pin, and 30 pounds of steam on low-pressure, 26 inches of vacuum, what pressure per square inch on the projected area of crank pin? C. S. D.

A.—(1) If there is no back pressure against the piston, and the full 140-pound boiler pressure is applied on the working side of the piston, then with the piston at or very near the end of the stroke, there would be a total pressure due to the steam of 140 pounds per square inch on a circle 60 inches in diameter. The area of this circle would be 2,827 square inches, and the total pressure would therefore be 395,800 pounds. The projected area of the crank pin would be 150 square inches, so that the pressure per square inch of projected area would be 2,639 pounds.

(2) With 120 pounds of steam on one side of the piston, and 30 pounds on the other, there would be a net force of 90 pounds per square inch acting against this piston. The areas remaining as before, we find that the pressure per square inch on the crank pin would be 1,696 pounds.

(3) For the same dimensions as before, and with 30 pounds pressure per square inch on one side of the piston, and a vacuum of 26 inches of mercury on the other, we would have a resulting net pressure of 43 pounds per square inch. This would give a total pressure on the crank pin of 810 pounds per square inch of projected area.

Additions to a Large Fleet.

The International Mercantile Marine has recently sold the steamers *Maine* and *Missouri,* built in 1903 and 1904 by the Maryland Steel Company, Sparrow's Point, Md., for the Atlantic Transport Company. These steamers have each a length of 491 feet 5 inches; a beam of 58 feet 2 inches, and a depth of 24 feet 4 inches; the net and gross tonnages being respectively 5,077 and 7,914. The steamers are of the three-deck and shelter-deck type, with nine bulkheads and a double bottom. They are propelled by twin screws actuated by triple expansion engines with cylinders 25, 42½ and 72 inches in diameter, with a common stroke of 48 inches. The indicated horsepower is 4,800. Steam is supplied by two double ended and two single ended Scotch boilers, each of a diameter of 14 feet 9 inches, and with lengths respectively 19 feet 3 inches and 10 feet 9 inches. The working pressure is 200 pounds per square inch. The grate area and heating surface are respectively 322 and 12,700, giving a ratio of 39.5 to 1.

Announcement has been made that the company is to add nine large steamers to a fleet now represented by 123 vessels, the new tonnage aggregating 127,530 gross tons, as compared with the present 1,015,761 tons. The main increases are in the Red Star line to Antwerp, and the Dominion line between Canadian ports and Europe.

An express mail, passenger and cargo steamer for the North Atlantic trade is to be added, which in point of luxury and size will far surpass anything hitherto attempted. Two other passenger and cargo steamers for the North Atlantic trade will be added, one of them to be placed in the Atlantic Transport service between New York and London. Two mail, passenger and cargo steamers will be added to the Dominion line in the Canadian service. A large cargo and passenger steamer has been designed for the London and Australian trade; and, finally, three steamers will be added to the Leyland line. It is expected that seven of these vessels will be in commission by the early part of 1909. The large express steamer and the second of the Canadian steamers will be a little later.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

850,239. BOAT LAUNCHING AND STOWING APPARATUS. FRED E. MARTIN, OAKVILLE, ONT., CANADA, ASSIGNOR OF ONE-THIRD TO WILLIAM J. KIVELL AND TWO-THIRDS TO CHARLES H. RICHES, BOTH OF TORONTO, CANADA.

Claim 1.—A boat launching and stowing apparatus comprising fixed trackways leading to the ship's side, davit-cranes movable on said trackways, a releasable bolt for securely holding the davit-cranes in their inboard position, means for arresting the davit-cranes at the limit of their outboard position and other releasable means to resist the return of the davit-cranes to their inboard position. Eighteen claims.

850,246. DEVICE FOR CLEANING SHIP BOTTOMS. JOHN H. PEGRAM, LONGSPUR, VA.

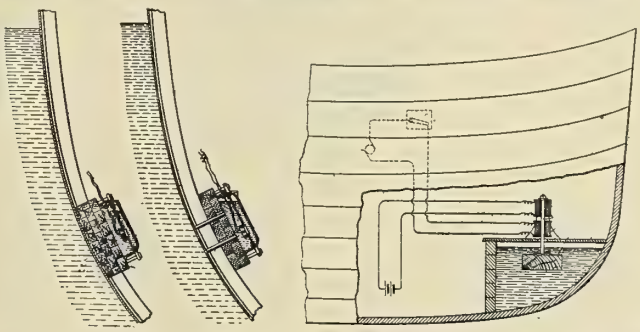
Abstract.—This invention relates to devices for cleaning ship bottoms without beaching the vessel or removing her from the water, and of that class including scraping means under buoyant influence to maintain the said means in contact with the submerged portion of the vessel, and permit the cleaner to be readily moved longitudinally or vertically, to thoroughly and effectively remove accumulations adhering to the hull below the waterline. The scraping means is caused to adhere closely to the side of the vessel, and brought to bear with sufficient force against the vessel's bottom to set up a thorough cleaning operation, by arranging a buoyant element or float under the scrapers and relying upon the tendency of the complete device to rise to the surface of the water, to effect a positive engagement of the scrapers with the side of the vessel. Three claims.

852,646. SYSTEM OF SUBMARINE SIGNALING. LUCIEN I. BLAKE, LAWRENCE, KANSAS, ASSIGNOR TO SUBMARINE SIGNAL COMPANY, BOSTON, MASS., A CORPORATION OF MAINE.

Claim 1.—The system of submarine signaling comprising in combination a submerged transmitter adapted for producing and imparting vibrations essentially molecular in character, and a submerged receiver sensitive to such vibrations. Four claims.

852,647. *Claim* 1.—The improvement in the art of submarine signaling by sound, which consists in intensifying the sounds produced or received by the resonance of an isolated mass of liquid. Ten claims.

852,648. *Claim* 1.—The improvement in the art of submarine signaling, consisting in the combination with a source or receiver of sound vibrations, of a body of consonant material directly associated in acoustic re-



lation therewith, and interposed between the same and the water, and adapted to intensify the vibrations by which it is excited. Seven claims.

852,649. *Claim* 1.—In submarine signaling by sound, the means herein described for producing and transmitting signals, comprising in combination a source of sound vibrations and a body of consonant material interposed between the same and the water, and adapted to be excited to consonance by the vibrations of said source. Six claims.

852,760. *Claim* 1.—A sound receiver for submarine signaling systems, comprising in combination a receptacle with walls capable of withstanding the variations of hydrostatic pressure accompanying regular periodic vibrations in a body of liquid contained therein, and reflecting the same to produce resonance, and a sensitive device adapted to be acted upon by such vibrations. Five claims.

850,473. GOVERNING DEVICE FOR MARINE ENGINES. WILHELMUS J. H. FRESEN, BRUSSELS, BELGIUM.

Claim 1.—In combination with the steam distributing gear, the steam distribution chamber and the steam supplying pipe of a marine engine, closing members independent of the distributing gear properly so called, said closing members being located in the steam distribution chamber, and a governor arranged in the steam supplying pipe of the engine, acting to partially or totally close the steam passage to the distributing gear by means of the closing members when the engine tends to race. Four claims.

851,072. SHIP CLEANING DEVICE. ROBERT B. CRUMP, BROOKLYN, N. Y.

Claim 1.—In a machine of the class described, a frame, a motor fixed to the frame, a shaft carrying hammers, bearing wheels on the shaft, and means for revolving the shaft. Seven claims.

851,080. VESSEL-POSITIONING DEVICE. CHARLES B. ERHART, CINCINNATI, OHIO, AND EDWARD GALATTI, COVINGTON, KY.

Abstract.—The invention relates to vessel positioning devices, and is especially applicable in connection with barges, for instance, coal barges, for use when unloading the latter, particularly when the unloading is being done by means of power shovels or excavators. It provides means whereby the power shovel or excavator and the means for positioning the barge may be operated from a common source of power, and in such manner that the slack of the cables from the barge-positioning drums to the barge or vessel may be taken up at all times. Six claims.

851,111. APPARATUS FOR CLEANING SHIPS. CHARLES E. ARNOLD, BRUNSWICK, GA.

Claim 1.—In a hull-cleaning device for ships and in combination, a rectangular frame, magnetic supporting runners at the corners of said frame, spring-held bearing blocks mounted in suitable standards on said frame, means for adjusting said bearing blocks, a rotary cleaning tool mounted in said bearing blocks, and means for driving said tool. Five claims.

851,269. VESSEL CONSTRUCTION. WILLIAM W. WOTHERSPOON, NEW YORK, AND ROBERT O. KING, NORTH TONAWANDA, N. Y.

Abstract.—The invention consists primarily in constructing the holds or compartments of the vessel so that they may at will be rendered air-tight or substantially so; providing each with an air-lock, and arranging for the introduction of air under pressure into the compartments, in order to expel any water which may have entered therein. Eleven claims.

851,270. METHOD OF FLOATING SUNKEN OR STRANDED VESSELS. WILLIAM W. WOTHERSPOON, NEW YORK, AND ROBERT O. KING, NORTH TONAWANDA, N. Y.

Abstract.—This invention relates to means employed for raising or removing stranded or sunken vessels, and consists of a method designed more particularly for the floating of stranded or partially submerged vessels, where the injury causing their wrecked condition is due to the leakage of water into the hold, either through a hole stove therein or through openings formed by other causes. The method involves the treatment of the wrecked vessel so as to render the compartment or hold, where the injury has occurred, air tight or substantially so; the introduction into said hold or compartment of air under pressure to expel the water; and finally the provision of means for permitting access by workmen into the hold, while the pressure is maintained, in order that proper repairs may be made. Four claims.

852,201. SEA-ANCHOR. FREDERICK ROUSE, HONOLULU, HAWAII.

Abstract.—The invention relates primarily to a sea anchor or drag, fitted with a peculiarly arranged oil reservoir by means of which not only may the vessel's head be kept to the wind while lying to, but oil distributed to windward of the vessel, thus breaking the seas and enabling the vessel to ride out a gale with comparative ease. Two claims.

852,380. BOAT. GUILLERMO A. FARINI, TORONTO, ONT., CANADA, ASSIGNOR OF ONE-HALF TO RENSSELAER HUNT, HAMILTON, CANADA.

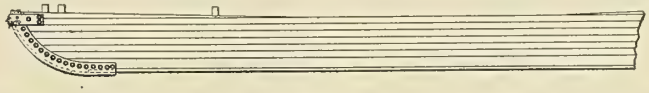
Claim 1.—In boat construction, a single tubular shell, longitudinal I-beams therein, and spaced straight girders, each passing centrally over the inner edge of one beam, and connected with the outer edges of the two beams on either side thereof. Three claims.

852,521. OSCILLATING PROPELLER. PER A. PETERSON, NEW YORK.

Claim 1.—In a propelling mechanism for boats, the combination of a lever pivotally connected directly to the boat, means for reciprocating said lever on its movable support, a blade pivotally connected to one end of the lever, a paddle carried by said blade, and a pivotal support for the upper end of said blade, said support being connected to the boat. Four claims.

852,987. BARGE, BOAT, AND SIMILAR VESSEL. GEORGE W. THEISS, PITTSBURG, PA.

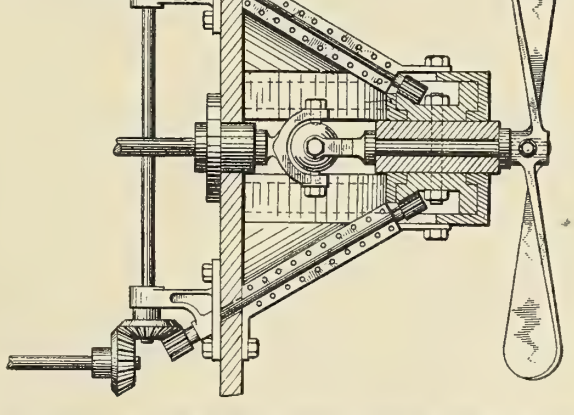
Claim 1.—In a barge, the combination with a wooden body portion, comprising a floor and sides, of metallic ends, each end consisting of curved



plates, curved angle bars carried by said plates, some of said bars being reinforced, a channel-shaped beam or sill connecting with said plates, tie plates connecting with said bars and beam, and means to detachably secure one of said tie plates and said bars to the sides of said barge. Five claims.

853,233. PROPELLER. ALOIS FLAD, NEW YORK.

Claim.—The combination with a boat, of a sectional propeller shaft, a universal joint between the sections thereof, a propeller carried by the outer section, semicircular guides secured to the aft of the boat, a sector slide capable of reciprocating in said guides, said slide being mounted on



the outer section of the shaft and having conical teeth on its upper and lower surfaces, cog wheels meshing with said sector and mounted on sloping shafts projecting through and borne in the boat, and means for transmitting movement to said cog wheels and sector slide to swing the propeller sideward. One claim.

853,331. ANCHOR. CHARLES B. ALYEA, INDIANAPOLIS, IND.

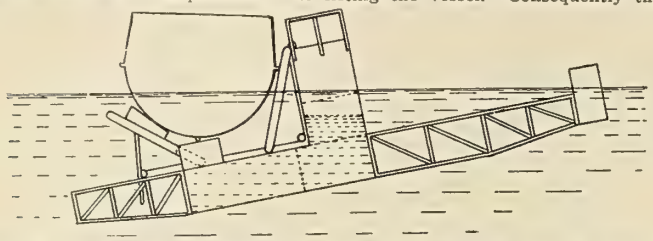
Claim 1.—The combination, in an anchor, of a main anchor rod, stay bars pivotally connected thereto, and anchor plates connected at their outer ends to said stay bars and at their inner ends longitudinally slidable on said main anchor rod with their inner ends initially above the outer ends. Six claims.

854,004. SUBMARINE BOAT. LAWRENCE Y. SPEAR, QUINCY, MASS., ASSIGNOR TO ELECTRIC BOAT COMPANY, NEW YORK, A CORPORATION OF NEW JERSEY.

Claim 1.—In a submarine or submergible boat having a tower through which ventilation may be effected, scuttles or hatches in the upper and lower portions of said tower for controlling admission thereto, and an air duct communicating with said tower above the bottom thereof and with the interior of the boat. Four claims.

853,328. FLOATING DOCK. ANDERS F. WIKING, STOCKHOLM, SWEDEN.

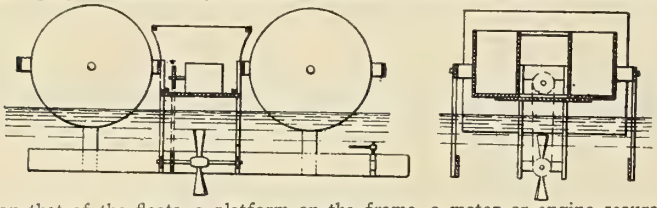
Abstract.—The present invention has for its object a floating dock, which is so arranged, that it assumes an inclined position during the admission of the water for the introduction of the vessel, and afterward is swung back in its horizontal position while lifting the vessel. Consequently this



dock is, as regards its stability, independent of special exterior arrangements or constructions, which is not the case with docks with one single, high, box-shaped wall. For effecting the swinging the pontoon is provided with an extension beyond the box-shaped wall, said extension forming a lever, around the outer end of which the swinging takes place. Four claims.

853,347. BOAT. AMEDEE FAYOL, BORDEAUX, FRANCE.

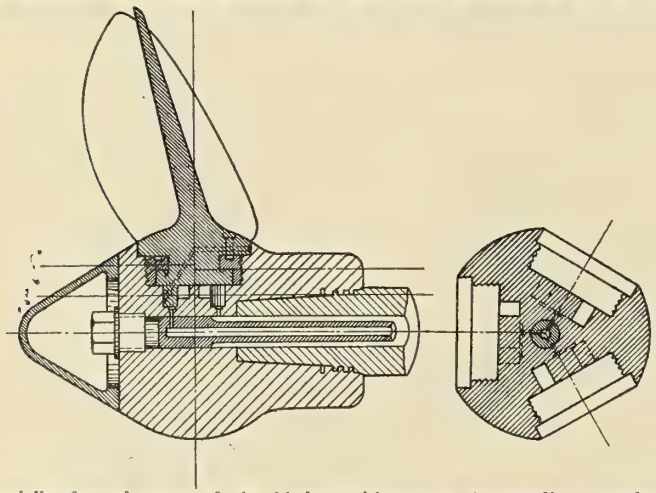
Claim 1.—A snip comprising the combination of a frame having parallel keels, of floats mounted in the said frame both in front and at the rear, a screw propeller carried by the frame between the keels and at a lower level



than that of the floats, a platform on the frame, a motor or engine secured on the said platform, and a supporting body for passengers and goods loosely located on the platform. Two claims.

853,999. PROPELLER. WILHELM SCHMID, SCHAFFHAUSEN, SWITZERLAND.

Abstract.—The invention relates to improved means for reversing propeller blades by fluid under pressure, the fluid being permitted to act on the



specially formed roots of the blades, without any intermediate members being interposed. Four claims.

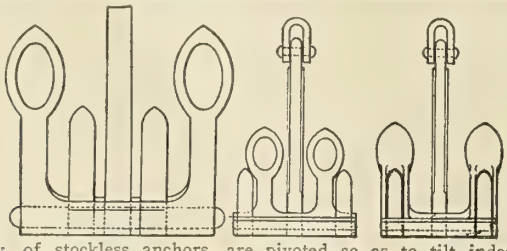
British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

89. FURNACES. B. HAIGH.

Smoke consuming fire bars.—At the back of the grate of a steam boiler furnace a chamber is provided for superheating a mixture of steam and air before its delivery, in a direction opposite to the line of draft, to the combustion chamber. Air, entering by a hood, passes through a pipe, mixes with steam from a jet, enters a chamber and escapes therefrom by a narrow slit or through apertures. The pipe and the chamber are protected by fire-brick, and part of the mixture of air and steam escapes through the apertures in the pipe. When forced draft is used, steam is also supplied to the ash pit, and the air and steam pass into the chamber through apertures formed in the fire bars.

395. ANCHORS. R. TURNER.

Supplementary flukes, fitted inside, outside, or through the main flukes,



respectively, of stockless anchors, are pivoted so as to tilt independently of the main flukes.

188. VENTILATING COWL. L. J. JOHNSEN.

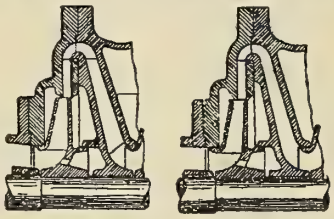
This relates to an interconvertible ships' ventilating cowl and boat. In order to adapt the cowl, when detached, for use as a boat, it is fitted with a hinged end plug forming the bow, a keel, a rudder, a hinged mast and sail, and a canopy which covers the mouth of the cowl when it is used as a boat. When the cowl is in ordinary use, the mast and end plug are housed.

268. RUDDERS; STEERING BY SCREW PROPELLERS. M. HOUZEAU.

The rudders of river boats are dismountable and arranged to carry the propeller, which is driven by a motor on the deck of the vessel. The shaft rotates in tubes connected by boxes containing bevel gearing. The tube is supported in bearings and may be adjusted in height by collars and a ratchet and screw. The whole apparatus is carried by pintles. The shaft is fixed in position, the rudder being turned by the tiller.

442. CENTRIFUGAL PUMPS AND FANS; TURBINES. C. H. JAEGER.

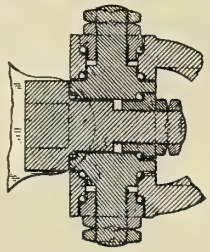
This relates to means for balancing the thrust on centrifugal pumps, fans, and the like, and consists in mounting the shaft with its impeller



so that they move slightly in a lateral direction, the edges of the delivery passage or of the impeller being formed conical or thinned so as to put the delivery in communication with the chamber on the opposite side of the impeller to that on which the thrust is given.

523. LOADING CARGOES. G. T. MACFARLANE.

This relates to the arrangement of a derrick and its winches for working cargo so as to be controllable by one attendant. The derrick is secured to the foot of the mast by double bands having sockets for the reception of the tang. The tang is connected to the derrick through the medium of a universal joint. A journal, extending from the head of the



tang, has a nut and lock nut screwed upon it so as to form a bearing with interposed antifriction balls for a gudgeon piece or gimbal. The member secured to the lower end of the derrick embraces this gimbal. Ball bearings adjusted by nuts and lock nuts, are provided. The upper end of the derrick has secured to it a swivel piece with eyes to which ropes may be fastened.

1,252. SHIPS' TELEGRAPHS. CHADBURN'S (SHIP) TELEGRAPH CO. AND A. J. GRANT.

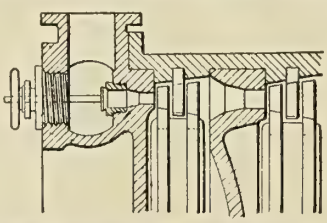
This relates to a mechanical telegraph for use on ships, in which the shafting is connected to the receiver by an intermittently acting and reducing mechanism, whereby the receiver pointer always moves to the center of the order transmitted. The shaft of the transmitter is connected by chains and sprocket-wheels to the shafting, the wheels being so related that the shaft has a larger angular movement than the handle. At the receiver, the shaft is connected to the pointer through an intermittently acting and reducing mechanism such as a Geneva stop-motion, or an intermittent screw motion. The telegraph is of the double type, with two transmitter handles. A modification is described similar to the above, but provided with tell-tale apparatus; four shafts, etc., being used.

1,545. SHIPS' ROLLERS, FAIR-LEAD. W. H. AND W. R. BANKS.

In a warp guide suitable for fishing vessels, space is saved without sacrificing strength by forming the gallows from a length of metal bent to form a hoop, the ends being secured to form a leg having plates bolted to the deck. From the top of the frame, which is stayed to the vessel, is suspended a swivel frame having a sheave, while on one of the plates is arranged a bracket parallel, or at an angle with, the leg and in which a sheave is journaled. The trawl boards are secured when inboard by turning down the plate threaded on the rotatable spindle.

1,568. ELASTIC FLUID TURBINES. R. SCHULZ.

A reversing turbine of a few rings of blades built on the same shaft as the turbine for forward travel is arranged for partial flow. The valves control the admission of steam to the nozzles, so that the pressure in the boiler during reversal may be maintained about normal, and available for



traveling forward when required. The admission to the nozzles of the second stage may be controlled by a suitable slide valve. Several arrangements for compounding these reversible turbines are described. For forward travel, steam is admitted and passes through the successive turbines to the condenser pipes, and, for reversing, steam drives the reversing turbines.